Biodiversity Inventory of the Gardenton PFRA Community Pasture

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Biodiversity Inventory of the Gardenton PFRA Community Pasture
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Cover photos, clockwise from left:
1. Cattle grazing in the Gardenton PFRA Community Pasture (Jamie Slogan, 1997).
2. Vegetation in the pasture (Jason Greenall, 1997).
3. PFRA Gardenton office, big bluestem in the foreground (Jamie Slogan, 1997).

Executive Summary

Inventories were conducted on the Gardenton PFRA Community Pasture between July and September of 1997. The pasture is located in southeastern Manitoba, adjacent to Minnesota. The inventory was conducted in three parts. The first part focussed on vascular plants and plant communities, the second on terrestrial vertebrates and butterflies, and the third on carabid beetles.

A survey of vascular plants and plant communities found 203 species in four habitat types. The aspen-oak woodland yielded 111 species; 121 species were found in the grassland, and 80 species occurred in the sedge meadows. Marshes were the least diverse with 44 species. In addition, 32 vascular plant species were recorded outside the plots in various habitats. Two species within the pasture are listed by the Manitoba *Endangered Species Act*. Great Plains ladies'-tresses (*Spiranthes magnicamporum*) is considered Endangered, and Riddell's goldenrod (*Solidago riddellii*) is listed as Threatened. COSEWIC (Committee on the Status of Endangered Wildlife in Canada) lists the latter as a species of Special Concern in Canada.

A survey of terrestrial vertebrates and butterflies recorded 101 species. Point counts revealed 34 species of birds were observed in the grassland, 23 in the woodland, 47 in edge habitats; five bird species were observed outside the plots. In total 77 bird species were recorded. The Rufous-sided Towhee (breeding populations rare in Manitoba) was observed in the bird survey. Four species of small mammals were recorded from snap traps, and 7 mammal species were observed in addition to the ones that were caught in the traps. Two species of reptile, five amphibian species, and six butterfly species were observed as part of this survey. This survey was the first recorded sighting in the area for the Western Painted Turtle and the Meadow Jumping Mouse.

The carabid beetle survey using pitfall traps and flight intercept traps identified 68 species in 24 genera. One species, *Bembidion praticola* Lindroth was recorded for the first time in Manitoba. Four species (*Anisodactylus pitychrous* LeConte, *Bembidion canadianum* Casey, *Bembidion nudipenne* Lindroth, and *Elaphrus fuliginosus* Say) rarely collected in Canada were found within the pasture.

Acknowledgments

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Introduction

Since the arrival of European settlers, much of southern Manitoba's native habitat has been lost to cultivation, grazing and urbanization. Native plant communities have largely been converted to cultivated land, in particular the tall grass prairie of the Red River Valley. It is estimated that less than 1% of tall grass prairie remains in its natural state throughout its historic range in Manitoba (Joyce & Morgan 1989). Surveys have revealed that Manitoba's largest and best remaining tall grass prairie habitat is located in southeastern Manitoba, near the towns of Tolstoi and Gardenton.

The Gardenton PFRA Community Pasture represents a sizeable block of mostly native habitat in southeastern Manitoba. Its location, between the Manitoba Tall Grass Prairie Preserve to the north and the Caribou Wildlife Management Area in Minnesota, makes it an important component of a larger block of habitat for plant and animal species in the region. Previous inventories were conducted nearby in the Tall Grass Prairie Preserve (Davis 1994, Borkowsky 1995, 1996, 1997), and within the Caribou Wildlife Management Area (Robert Dana, pers. comm. 1997), but a lack of information on the pasture made it difficult to assess its importance in the region.

The Manitoba Conservation Data Centre, funded by the Canadian Wildlife Service (CWS) and Prairie Farm Rehabilitation Administration (PFRA) completed a biodiversity inventory of the Gardenton PFRA Community Pasture between July and September 1997. The objective of the project was to produce an overall list of species found in the Gardenton Community Pasture. The inventory was conducted in three parts. The first component of the project inventoried the plant communities of the pasture, documenting their species composition and producing a list of vascular plants. The second component was an inventory of the vertebrate fauna of the Gardenton PFRA Community Pasture. Standardized sampling was performed for birds and mammals, and incidental observations of other vertebrate species were also kept to facilitate the production of an overall vertebrate species list for the pasture. In addition, a survey of butterflies was undertaken to search for provincially rare species known to occur in this area of Manitoba. For the third component, only a small component of the entire insect biodiversity was inventoried due to time constraints. The carabid beetles were chosen because of the following characteristics of the family: (1) ease of identification, (2) well-known natural history and (3) ease of sampling.

Study Area

The Gardenton Community Pasture was created in 1961 to allow grazing of cattle on Crown land. The pasture covers 5,004 hectares located along the Canada-United States border south of Gardenton, Manitoba in Township 1, Ranges 6 and 7 EPM (Figure 1). The pasture measures 12 km from east to west, and 8 km from north to south. The original boundary has not changed since 1961 but cross fences have been added to separate herds of animals, and to facilitate rotational grazing. In 1997, 1,676 cattle grazed the pasture (including 622 calves), as well as 64 horses and 14 colts (Kevin Johnson, pers. comm. 1997). The pasture borders the Caribou Wildlife Management Area (Minnesota) to the south, the Roseau River diversion to the east, and a mix of cultivated land and pastures to the west and north. The Manitoba Tall Grass Prairie Preserve is located a few kilometres to the north and west.

The history of the land is extensive, dating back to the turn of the century. Immigrants mainly of Ukrainian descent settled the land in the late 1800's, but the land was difficult to work because of the many large stones and poor soil drainage. After World War II few people returned, and those that had stayed behind began to leave because of the tough conditions (Harvey Hill, pers. comm. 1997). The land reverted to the Crown as settlers abandoned it. Today a number of cement foundations and a cemetery can still be found serving as reminders of these people.

Topography within the community pasture is flat to very gently rolling. The elevation of the pasture is highest in the southeast corner (~ 311 m ASL) and slopes downward toward the northwest corner (~ 301 m ASL). The region was once a beach ridge of Glacial Lake Agassiz, and as such does not have the same heavy clay soils as the Red River Valley to the west. The soil in the majority of the pasture consists of

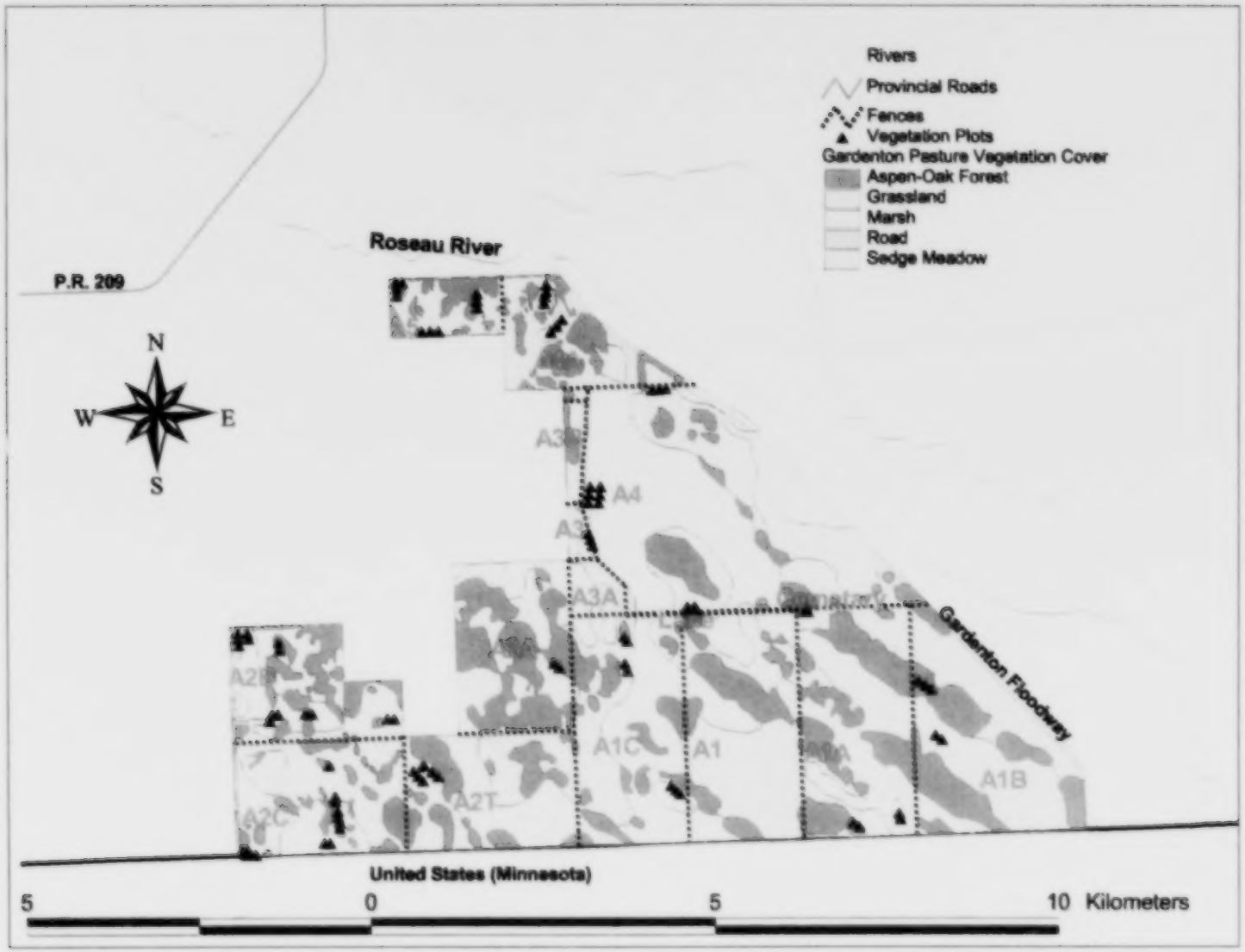

Figure 1. Gardenton PFRA Community Pasture, including field numbers, vegetation cover classes, and locations of vegetation sample plots.

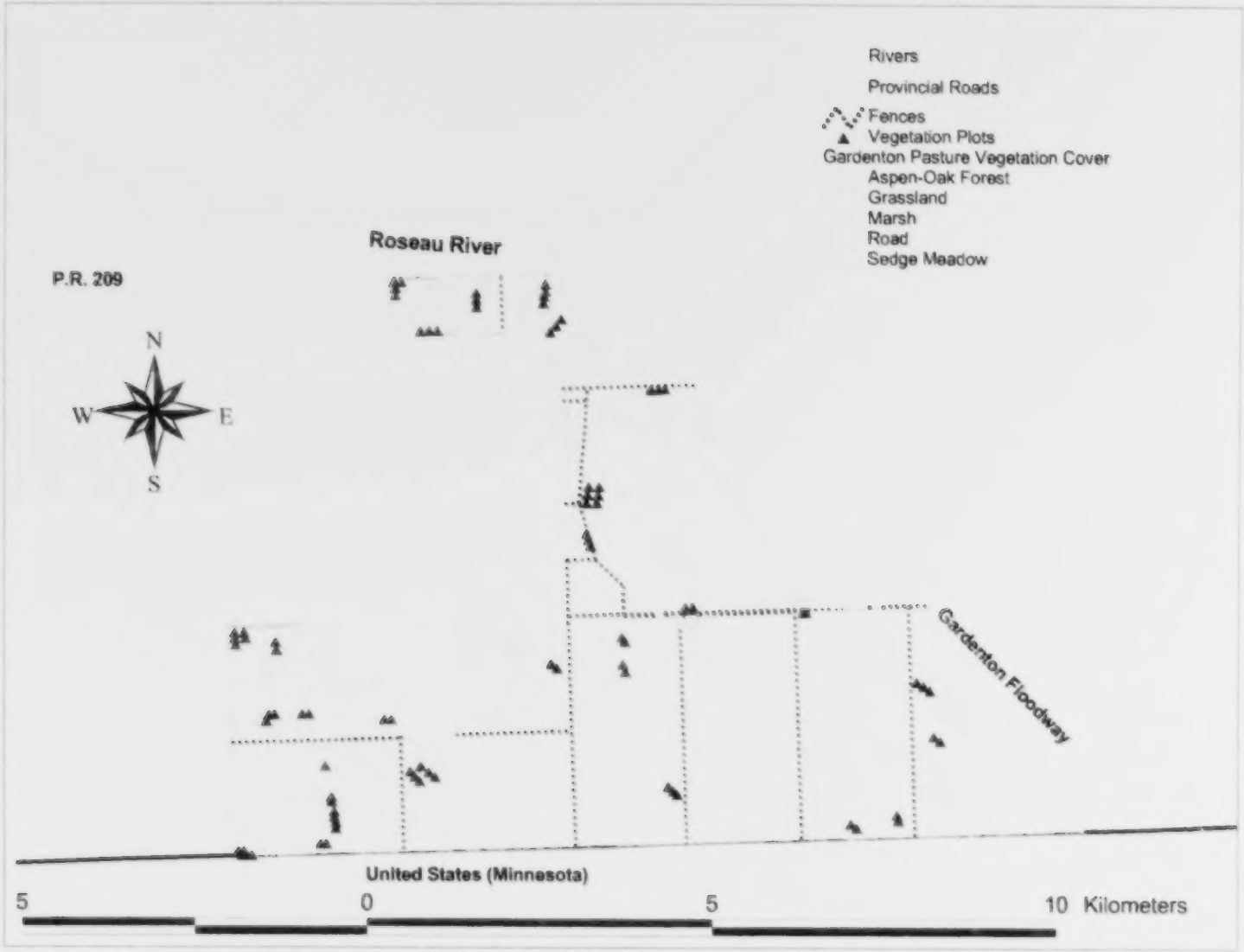

Figure 1. Gardenton PFRA Community Pasture, including field numbers, vegetation cover classes, and locations of vegetation sample plots.

sandy clay-loam or sandy loam deposited over a stony calcareous till (Ehrlich et al. 1976). The pasture is generally poorly drained, however drainage improves with increasing depth of the sandy layer. This creates a ridge-and-swale topography, with the poorly drained depressions consisting of wet meadows, grading into wet prairies and eventually into woodlands on the higher, better-drained ridges. The northwest to southeast orientation of these sandy ridges is evident in the pattern of vegetation on the landscape. Shallow peat deposits in the eastern portion of the pasture adjacent to the Roseau River diversion support marsh and wet meadow habitats.

The vegetation of the Gardenton Pasture can be broken down into four major habitats: woodlands, grasslands, wet sedge meadows, and marshes. These habitats occur along a moisture gradient, from relatively dry uplands to saturated wetlands.

Methods

Vascular Plants and Plant Communities

The inventory took place between July 4 and August 26, 1997. The vegetation of the pasture was broken down into four general habitat types: grassland, woodland, sedge meadow and marsh. Areas to be sampled were chosen using air photographs and Landsat (TM) classified imagery for the pasture (Manitoba Remote Sensing Centre 1994).

Sampling of plant communities was based on the techniques of Greig-Smith (1983) and Kershaw (1975). Sampling plots 10 m x 10 m in size were placed at 100 m intervals along a transect. Length and orientation of the transect was dependent upon the size of the community type being sampled. Large communities were sampled with a 200 m long transect (three plots). Smaller patches were sampled with only a 100 m transect (two plots), or with a single plot. In large communities, transects were generally run north to south; in smaller patches, transects were run along the longest axis of the vegetation patch to maximize the number of plots.

Trees (woody species with stem diameter at breast height (DBH) greater than 7 cm) were sampled within the 10 m x 10 m plot. Data collected included an estimate of tree canopy cover and measurement of density in the plot. Frequency of each tree species was calculated. A size distribution was also made by separating trees into three DBH size classes: Size 1 = DBH 7 - 12 cm, Size 2 = DBH 13 - 17 cm, and Size 3 = DBH > 17 cm.

Shrubs (woody plants > 1 m in height and with DBH < 7 cm) were sampled in a 5 m x 5 m quadrat, nested in the southeast corner of each 10 m x 10 m plot. Shrub density of each species was sampled by counting the number of individual stems in the 5 m x 5 m quadrat.

Species in the ground stratum (herbaceous species and woody species less than 1 m in height) were sampled in five 1 m x 1 m quadrats randomly placed within the 10 m x 10 m plot using a random number table. Species cover was estimated using a modified Braun-Blanquet cover scale with five cover classes: 0 - 5%, 6 - 25%, 26 - 50%, 51 - 75%, and 76 - 100%. Mean cover was calculated using midpoints of each cover class. Frequency of each ground cover species was calculated by quadrat (using presence in each 1 m x 1 m quadrat), as well as by plot (using presence of a species in any of the five quadrats in the 10 m x 10 m plot). Formulae used for vegetation analyses are included in Appendix A.

Thirty-seven transects were run in the various habitats, resulting in the sampling of 87 10 m x 10 m plots, 87 5 m x 5 m quadrats, and 435 1 m x 1 m quadrats. Twenty-eight 10 m x 10 m plots were located in grasslands, compared with 23 in woodlands, 18 in sedge meadows, and 18 in marshes.

Plant species encountered outside of sampling units were noted for inclusion in the overall species list for the Gardenton Pasture (Appendix B). Voucher specimens were deposited in the University of Manitoba herbarium (WIN). Nomenclature follows Scoggan (1978).

A map of vegetation types for the Gardenton community pasture was produced for 1997 using ArcInfo® 2.1. The final map was based upon information taken from a 1984 contract map, a set of 1988 aerial photographs, a 1990 NTS 1:50,000 topographic map, Landsat (TM) classified satellite imagery (Manitoba Remote Sensing Centre 1994), and observations made in the field during the summer of 1997.

Terrestrial Vertebrates and Butterflies

An initial assessment of the Gardenton PFRA Community Pasture found that the majority of the area consists of grasslands and wet meadows interspersed with aspen woodland. This assessment was based on topographic maps and aerial photography, along with knowledge of the surrounding area. Based on this assessment, three major habitat types were delimited for this portion of the inventory: grassland (tall grass prairie), aspen woodland, and edge (the transition zone between grassland and woodland). Within these three habitat types, quantitative data were collected for birds and mammals, using point count surveys for birds and snap traps for small mammals. In addition, lists of mammals, birds, reptiles, amphibians and butterflies were developed based on general observations throughout July and August 1997.

Sites for bird and mammal data collection were selected based on the requirements of the point count method for surveys of birds (Dale and Holroyd 1994). These sites require a relatively large area of homogeneous habitat, which limits where they can be placed in a fragmented landscape. According to Dale and Holroyd (1994), a minimum of 10 to 12 sites are required within a homogenous habitat area to adequately account for the bird species within that habitat type. Each site consists of a circle with a radius of either 50 or 100 metres, depending upon the type of habitat being sampled. Grassland habitat, because it is wide open, requires a 100 m radius circle for a reliable accounting of the majority of bird species. Forest habitat, depending on the density of the trees, requires less area for species detection - a circle with 25 m to 50 m radius is sufficient (Ralph et al. 1993). Sites are laid out such that the centre points of neighbouring circles are at least 250 m apart.

Inspection of the pasture determined that no homogenous areas were large enough to set up 12 point count sites. Therefore, three representative sampling areas were selected each of which contained the three desired habitat types. Four count sites were placed in each of the three habitat types in each sampling area. The sampling areas were selected by inspection, with the assistance of pasture manager Kevin Johnson. The three sampling areas settled upon were located in southern, central and northern portions of the pasture, allowing them to capture more of the pasture's variability.

Three candidate areas were selected during the week of July 7, and changed somewhat before being finalized during the week of July 14. A number of the initial sampling areas were either too small to accommodate the number of required replicates, or were too inaccessible given the rugged terrain and high water levels which had to be crossed to reach them. The final locations of the three areas are described in Table 1; field numbers can be seen in Figure 1. Sampling dates are outlined in Table 2.

Table 1. Description of sampling areas used for bird point counts and small mammal trapping transects, Gardenton PFRA Community Pasture, July - August 1997.

Sampling Area	Location	Description
1	Tony Field North (Field A2B) NW 1-1-6E, NE 2-1-6E, S½ 11-1-6E & SW 12-1-6E	Large meadow scattered with aspen, moderately grazed. To the north - private land, very wooded. To the west - private land, grassland with a strip of woodland. To the east and south - pasture, wet meadow and aspen, moderately to heavily grazed.
2	Nicole Field, Lake Field West and Lake Field East (Fields A2A, A1C and A1) NE 7-1-7E, NW 8-1-7 & 9-1-7E (full section)	Wet meadow (NW), wet grassland (NE) with fairly dense aspen in SW & SE, lightly to moderately grazed. To the north & south - wet meadow and marsh, grazed where dry. To the east - grassland with scattered oak, pretty grazed out, cemetery site. To the west - very wet meadow and marsh.
3	Headquarters and Swamp Field (Fields A5 and A4A) NE 25-1-6E, N½ 30-1-7E	Meadow behind the pasture headquarters, moderately grazed, grading into a swampy area to the east. To the north - road and private land, forest (and grazed grassland?). To the south - private land, hayed. To the east - aspen, marsh & swamp. To the west - private land, wooded (and grazed or hayed).

A point count survey for bird species composition and relative abundance was conducted in each of the three habitat types within each of the three areas. Set-up within each habitat type consisted of 12 circular sites, each with 100 m radius (50 m radius for aspen), with no less than 50 m between site perimeters. Topographical maps and aerial photographs were examined to determine the placement of each plot and the route by which to access them. The centre of each point count site was marked with a five-foot length of rebar, flagged and labelled for easy site identification. The perimeters of each point were marked with four reference points (north, south, east and west), located at a radius of 100 m for grassland and edge habitats and 50 m for aspen woodland habitat. For each site, a general habitat map was produced, and filed with the Manitoba Conservation Data Centre. Latitude and longitude of each site was also measured using a Global Positioning System (GPS) unit (Appendix C).

Point count sampling periods consisted of three 3-day intervals. The 12 point count sites in each sampling area required one day to sample, as listening stops could only be made for up to four hours after dawn. The order in which the areas were sampled was chosen randomly, as was the first site to be sampled within each area. Once a site was chosen, the order of sampling each site followed a counter-clockwise path. This path ensured that time used to travel between sites was minimal.

The bird surveys were conducted as follows. The centre of each point count circle was approached with as little disturbance to the birds as possible. Counts began immediately upon reaching the census point. Birds within the count circle radius were counted within a 5-minute period, separating those counted within the first 3 minutes (for future comparison with Breeding Bird Surveys) and those additional individuals heard in the remaining 2 minutes. For additional details on this procedure, see Ralph et al. (1993), and Dale and Holroyd (1994).

Mammal trapping was delayed a week from the initial point count sampling date to allow the sampling areas to dry up. Sampling then took place in the driest area first to ensure enough dry ground to set up the trapping transects. Sampling dates are shown in Table 2.

Small mammal populations were sampled using snap traps, placed in a transect running through the centre point of selected bird plot transects. Each small mammal transect consisted of 30 Museum Special snap traps, baited with peanut butter, oatmeal and raisins. General locations of small mammal traps are shown in Table 3; field numbers can be seen in Figure 1. The latitude and longitude of trapping locations are given in Appendix C.

Trapping took place over three consecutive nights in a sampling area, with one sampling area being done per week (Table 2). This represents 270 trap nights for each habitat type (30 traps x 3 areas x 3 nights). Traps were set one day, then checked for the next three days, and were reset and re-baited when necessary. Specimens were placed in paper bags with the date, trap number, specimen and habitat type recorded on the bag while in the field. The specimens and information were later transferred to a freezer bag and stored.

Table 2. Sampling schedule for point counts of birds and trapping of small mammals, Gardenton PFRA Community Pasture, July - August 1997.

Sampling Period	Date	Point Count Sampling Area	Point Count Sampling Order	Mammal Trapping Area
1	July 22	1	7, 8, 5, 1, 2, 3, 4, 6, 9, 10, 11, 12	-
	July 23	3	9, 12, 11, 10, 1, 2, 3, 4, 5, 6, 7, 8	-
	July 24	2	3, 4, 5, 6, 2, 1, 7, 8, 9, 10, 11, 12	-
2	July 30	3	2, 3, 4, 5, 6, 7, 8, 9, 12, 11, 10, 1	1
	July 31	2	11, 12, 10, 9, 8, 7, 5, 6, 4, 3, 2, 1	1
	August 1	1	5, 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12	1
3	August 6	2	5, 6, 4, 3, 2, 1, 7, 8, 9, 10, 12, 11	3
	August 7	1	1, 2, 3, 4, 9, 8, 7, 6, 5, 10, 11, 12	3
	August 8	3	4, 5, 6, 7, 8, 9, 12, 11, 10, 1, 2, 3	3
4	August 13	-	-	2
	August 14	-	-	2
	August 15	-	-	2

Table 3. Locations of small mammal trapping transects, Gardenton PFRA Community Pasture, July - August 1997. Transects ran through the centre point of bird point count sites.

Sampling Area	Location	Habitat	Notes
1	NW 1-1-6E	Grassland	running E-W along site #5
	SW 12-1-6E	Edge	running E-W along site #1
	NE 2-1-6E	Aspen	running N-S along site #7
2	9-1-7E	Grassland	running E-W along site #5
	9-1-7E	Edge	running E-W along site #4
	9-1-7E	Aspen	running N-S along site #7
3	NW 30-1-7E	Grassland	running E-W along site #5
	NW 30-1-7E	Edge	running N-S along site #6
	NE 25-1-6E	Aspen	running N-S along site #10

Carabid Beetles

An inspection of the Gardenton Community Pasture was done in early July. The pasture was extremely wet, and only two access points were useable. Field A2C (Figure 1) was the focus of the surveys, mainly

because other areas were not accessible. Cattle were not present in pasture A2C when the traps were set up, but were allowed into the pasture shortly after.

The locations of the insect traps were chosen based on moisture levels in order to provide information on ecology of the species found. Traps were installed on July 7, 1997, and sampled every week thereafter (July 14, 21, 28, August 4, 11, 18, and 25, and September 1, 8, and 15), for a total of ten weekly sampling periods. Voucher specimens were deposited in the following collections (selected because of resident specialists on Carabidae):

- J.B. Wallis Museum, Department of Entomology, University of Manitoba, Winnipeg, MB.
- Canadian National Collection of Insects, Agriculture Canada, Ottawa, ON.
- Division of Entomology, Carnegie Museum of Natural History, Pittsburgh, PA.
- Department of Entomology, California Academy of Sciences, San Francisco, CA.

Insect and other invertebrate specimens were collected using two different kinds of traps, pitfall traps and flight intercept traps. Pitfall trapping is widely used as a technique for sampling terrestrial arthropods that fall into the traps, where they are killed and preserved. Flight intercept traps are used primarily to collect flying insects, especially those with a tendency to fall to the ground upon meeting an obstacle. Sixty unbaited pitfall traps were installed on the pasture, along with four flight intercept traps.

Each pitfall trap (PF) consisted of a 4 x 4 inch square plywood cover with nails hammered through at the corners, two 500 ml plastic tubs (one inside the other), and about 250 ml of a saturated salt (NaCl) solution. The tubs were placed in a hole dug with a post-hole auger, filled with the salt solution, then covered with the lid. Traps were numbered from 1 to 60. Traps were placed throughout the pasture, in areas varying in moisture and plant cover. The prairie was quite wet at the time of the initial installation, and it was difficult to find areas that were dry enough for pitfall and flight intercept trapping. The 60 traps were distributed as shown in Table 4.

Table 4. Locations of pitfall traps in the Gardenton PFRA Community Pasture.

Trap series	Location	Moisture level
1-5	in open pasture	Low
6-10	in and around small group of willows	Medium
11-20 (note: 10 traps)	along margin of aspen copse	High
21-25	open area near aspen copse	Low
26-30	in large aspen grove	Medium
31-35	tall grass	Low
36-40	along road near dead poplar	Medium
41-45	near aspen copse	Medium
46-50	along margin of aspen copse	Medium
51-55	on meadow	Low
56-60	along ditch with permanent water	Very High

The pitfall trap samples were taken by removing the inner tub, pouring its contents through a sieve, with the salt solution being returned to the trap in a third tub. In this way, a single empty tub was carried from trap to trap, with the residues collected in the sieve. Each trap series was treated as a sampling unit, so that the contents of traps 1-5 were pooled, but kept separate from 6-10, 11-20, and so on.

Flight intercept traps (FITs) were constructed of a panel of no-see-um mesh approximately 1.2 m by 1.4 m, fixed between two upright poles. A trough of PVC pipe 0.1 m in diameter was sunk into the ground under the FIT panel; therefore the FIT acted both as a flight intercept and (probably more importantly, judging by

beetles collected) also a large pitfall trap. The poles were anchored to the surrounding trees using rope. Each FIT panel was treated with a single application of a commercial insecticide immediately after installation to increase the catch of flying insects. The four flight intercept traps were placed at the margins of aspen groves, on or near slightly to very wet ground. The data from flight intercept traps 1 and 2 were pooled. Traps 3 and 4 were also pooled, based on their proximity to each other.

The samples were sorted into the following groups: (1) adult Carabidae; (2) other adult beetles; (3) beetle larvae; (4) spiders. Insects were removed from the residues and placed into 70% ethanol for later preparation. Although only the adult Carabidae were used in this preliminary inventory, the other material (including the specimens not falling into categories 2-4) will be valuable to further studies, both of the PFRA pasture, and prairie biodiversity generally. The adult carabids were identified using Lindroth (1961-69), counted, and the data were entered into a spreadsheet program. Taxonomically problematic genera (e.g. *Harpalus*, *Amara*, *Agonum*) were identified or confirmed by Dr. Yves Bousquet, an expert on Carabidae at the Canadian National Collection of Insects, Ottawa.

The species and number of specimens were kept for each trap series, and summed to establish a species list for the entire study area. This total was then compared with similar data from a tall grass prairie site on the St. Charles Rifle Range, Winnipeg.

Results

Vascular Plants and Plant Communities

Woodlands

Wooded areas accounted for approximately one quarter of the Gardenton Pasture. Large woodlands occurred on upland ridges that ran in a southeasterly direction in the southern half of the pasture. Smaller wooded groves were scattered within sedge meadow and grassland communities elsewhere within the pasture.

A total of 111 plant species were encountered in wooded areas of Gardenton Community Pasture. Trembling aspen (*Populus tremuloides*) was the dominant tree species in the pasture and was associated with bur oak (*Quercus macrocarpa*) in drier areas, and balsam poplar (*Populus balsamifera*) in moister areas (Table 5). Trembling aspen represented approximately 43% of canopy cover, while bur oak and balsam poplar were less abundant. Most stands consisted mainly of immature to medium sized aspen with large bur oak and balsam poplar individuals scattered throughout. Small populations of Manitoba maple (*Acer negundo*) and green ash (*Fraxinus pennsylvanica*) were found near remnant home foundations. A cottonwood (*Populus deltoides*) was found in field A4A near a stream draining the pasture. The shrub layer consisted mainly of beaked hazelnut (*Corylus cornuta*) (Table 6). Other frequently encountered shrubs included red-osier dogwood (*Cornus stolonifera*), prickly rose (*Rosa acicularis*), Saskatoon (*Amelanchier alnifolia*), raspberry (*Rubus idaeas*), and immature individuals of bur oak and trembling aspen. Common herbaceous species included wild strawberry (*Fragaria virginiana*), northern bedstraw (*Galium boreale*), poison ivy (*Rhus radicans*), tall meadow-rue (*Thalictrum dasycarpum*), and golden Alexanders (*Zizia aurea*) (Table 7). Graminoid species included redtop (*Agrostis stolonifera*), sedge (*Carex* spp.), and blue grass (*Poa* spp.). Redtop, slough grass (*Spartina pectinata*), and white clover (*Trifolium repens*) were abundant in openings in the canopy and along woodland edges.

Grasslands

Grasslands within the pasture can be divided into two categories, based on grazing intensity. Native tall grass prairie dominated by big bluestem (*Andropogon gerardii*), redtop, slough grass and spike-rush (*Eleocharis* spp.) was located in the northern portion of the pasture where grazing was light. Where grazing was heavier redtop, northern reed grass (*Calamagrostis inexpansa*), tufted hairgrass (*Deschampsia caespitosa*), and spike-rush were abundant.

In total, 123 plant species were documented within the grassland areas. Trees were absent and shrubs were rare within these grasslands, with basket willow (*Salix petiolaris*), trembling aspen, and prickly rose most abundant (Table 8). Big bluestem had the highest mean cover of grass species, however redtop, northern reed grass, and slough grass were encountered more frequently. Other common species included woolly sedge (*Carex lanuginosa*), brown sedge (*Carex buxbaumii*), Baltic rush (*Juncus balticus*), and spike-rush. Forb cover consisted mainly of white clover (*Trifolium repens*), northern bedstraw, silverweed (*Potentilla anserina*), northern bog violet (*Viola nephrophylla*), many-flowered aster (*Aster ericoides*), and goldenrods (*Solidago rigida* and *S. nemoralis*) (Table 9).

Sedge Meadows

Sedge meadows occupied approximately one half of the Gardenton Pasture and occurred in poorly drained lowland areas. Cattle grazed these areas lightly, as they preferred the drier grasslands and woodlands.

Seventy-eight plant species were recorded throughout sedge meadow plant communities. Basket willow and Bebb's willow (*Salix bebbiana*) were common, forming dense patches in some areas of the pasture (Table 10). The most abundant species were woolly sedge, brown sedge, spike-rush, slough grass, Baltic rush, knotted rush (*Juncus nodosus*), common mint (*Mentha arvensis*), water hore-hound (*Lycopus americanus*), and northern reed grass (Table 11). Where standing water persisted throughout the summer, hairy- fruited sedge (*Carex lasiocarpa*) was dominant. Grassland species such as tufted hairgrass were associated with drier areas.

Marshes

Marsh communities occur in poorly drained depressions where standing water remains throughout the summer. Land adjacent to the Roseau River diversion in the eastern portion of the pasture appears to be flooded regularly. Marsh habitat contains relatively low species richness, being dominated by common cattail (*Typha latifolia*), lake bulrush (*Scirpus lacustris*), and greater bladderwort (*Utricularia vulgaris*).

Marsh was the least common habitat type within the pasture, as well as the least species-rich, with only 44 species observed. Typically, a few species were dominant such as common cattail, hairy-fruited sedge, beaked sedge (*Carex rostrata*), and water sedge (*Carex aquatilis*) (Table 12). Common forbs included greater bladderwort, various-leaved pondweed (*Potamogeton gramineus*), water smartweed (*Polygonum amphibium*). No shrubs were sampled, but basket willow, Bebb's willow, and swamp birch (*Betula pumila*) were observed outside of the plots.

Table 5. Aspen - oak woodland tree canopy cover, density and distribution by DBH size class, Gardenton PFRA Community Pasture, sampled July - August 1997 (n = 23 plots).

Species	Mean Canopy Cover (%)	Total Individuals	Density (trees/ha)	Size 1	DBH Size 2	Size 3
Populus tremuloides	42.52	185	804.3	145	27	13
Quercus macrocarpa	15.80	37	160.9	14	17	6
Populus balsamifera	5.89	9	39.1	3	1	5
Open Canopy	31.22	-	-	-	-	-

Table 6. Aspen - oak woodland shrub density, Gardenton PFRA Community Pasture, sampled July - August 1997 (n = 23 quadrats).

Species	Mean density (stems/5 m x 5 m)	Mean density (stems/ha)
Corylus cornuta	13.26	5304.35
Populus tremuloides	4.35	1740.00
Quercus macrocarpa	3.52	1408.70
Cornus stolonifera	2.43	973.91
Amelanchier alnifolia	1.13	452.17
Populus balsamifera	0.87	347.83
Salix lutea	0.48	191.30
Betula pumila	0.43	173.91
Crataegus rotundifolia	0.43	173.91
Salix petiolaris	0.31	123.48
Salix bebbiana	0.22	86.96
Rosa acicularis	0.17	69.57
Prunus virginiana	0.13	52.17
Salix spp.	0.13	52.17
Rubus idaeus	0.04	17.39
Ulmus americana	0.04	17.39

Table 7. Mean cover and frequency of aspen-oak woodland ground stratum, Gardenton PFRA Community Pasture, sampled July-August 1997 (n = 115 quadrats from 23 plots). Ground stratum consists of herbaceous species plus woody species (shrubs and trees) less than 1 m in height.

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Corylus cornuta	17.65	56.52	86.96
Agrostis stolonifera	13.01	53.96	78.26
Fragaria virginiana	12.83	71.3	100
Rhus radicans	11.03	39.13	69.57
Rosa acicularis	7.67	48.74	82.61
Carex spp.	6.93	40	56.52
Cornus stolonifera	6.8	37.43	73.91
Quercus macrocarpa	5.52	29.7	86.96
Poa spp.	5.35	37.39	69.57
Galium boreale	4.97	60	95.65
Trifolium pratense	4.73	2.61	13.04
Agropyron trachycaulum	3.94	24.35	30.43
Calamagrostis canadensis	3.34	21.74	30.43
Sonchus arvensis	3.22	23.48	47.83
Taraxacum officinale	3.22	13.91	30.43
Zizia aptera	3.13	3.48	8.7
Zizia aurea	3.13	34.78	65.22
Salix petiolaris	3.1	2.61	4.35
Maianthemum canadense	2.87	22.65	52.17
Lathyrus venosus	2.59	19.13	52.17
Andropogon gerardii	2.52	7.83	17.39
Populus tremuloides	2.47	15.65	43.48
Rubus idaeus	2.45	5.22	13.04
Amelanchier alnifolia	2.43	15.65	26.09
Aster ciliolatus	2.12	26.09	65.22
Equisetum pratense	2.1	10.43	13.04
Vicia americana	1.67	10.52	39.13
Viola pubescens	1.67	6.96	17.39
Smilax herbacea	1.63	6.17	26.09
Anemone canadensis	1.4	13.13	47.83
Solidago rigida	1.38	6.96	21.74
Achillea millefolium	1.31	21.74	78.26
Lathyrus palustris	1.29	12.17	30.43
Ribes oxyacanthoides	1.23	13.09	43.48
Carex lanuginosa	1.22	9.57	17.39
Phleum pratense	1.17	10.52	39.13

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Panicum virgatum	0.97	8.7	21.74
Viola nephrophylla	0.93	13.91	30.43
Aster simplex	0.78	8.7	30.43
Smilacina stellata	0.73	4.39	17.39
Agrimonia striata	0.72	1.74	8.7
Aster laevis	0.65	7.83	21.74
Pyrola elliptica	0.62	3.48	8.7
Spartina pectinata	0.62	26.13	52.17
Prunella vulgaris	0.61	6.17	39.13
Symphoricarpos occidentalis	0.57	1.74	4.35
Antennaria spp.	0.54	3.52	17.39
Solidago nemoralis	0.51	1.74	8.7
Carex brevior	0.45	4.35	17.39
Thalictrum venulosum	0.4	0.87	4.35
Danthonia spicata	0.31	3.48	8.7
Betula pumila	0.29	2.61	8.7
Calamagrostis inexpansa	0.29	2.61	4.35
Hieracium scabriusculum	0.29	6.96	21.74
Asclepias ovalifolia	0.27	1.78	13.04
Carex praegracilis	0.27	1.74	4.35
Crataegus rotundifolia	0.27	1.74	4.35
Juncus nodosus	0.27	1.74	8.7
Viola spp.	0.2	13.91	30.43
Campanula rotundifolia	0.18	2.65	13.04
Sanicula marilandica	0.18	24.35	52.17
Aster puniceus	0.18	2.61	13.04
Melilotus alba	0.18	2.61	8.7
Salix exigua	0.18	0.87	4.35
Salix lutea	0.18	2.61	8.7
Spiraea alba	0.18	3.48	8.7
Anemone cylindrica	0.16	1.78	13.04
Equisetum arvense	0.16	1.74	4.35
Solidago canadensis	0.16	20.04	47.83
Steironema ciliatum	0.16	2.61	8.7
Steironema quadriflorum	0.16	1.74	4.35
Trifolium repens	0.16	23.48	43.48
Crepis tectorum	0.13	0.87	4.35
Glycyrrhiza lepidota	0.13	3.48	4.35
Lycopus americanus	0.13	0.87	4.35

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Pedicularis canadensis	0.13	0.87	4.35
Pyrola asarifolia	0.13	0.87	4.35
Rudebeckia hirta	0.13	0.13	13.04
Salix discolor	0.13	0.87	4.35
Thalictrum dasycarpum	0.13	28.83	73.91
Senecio aureus	0.11	2.65	13.04
Helianthus laetiflorus	0.05	1.78	8.7
Carex aurea	0.04	1.74	4.35
Cirsium arvense	0.04	1.74	8.7
Equisetum hyemale	0.04	1.74	4.35
Hierochloe odorata	0.04	1.74	8.7
Juncus balticus	0.04	1.74	8.7
Asclepias syriaca	0.02	0.87	4.35
Aster ericoides	0.02	0.87	4.35
Carex rostrata	0.02	0.87	4.35
Carex crawei	0.02	1.74	4.35
Comandra umbellata	0.02	0.87	4.35
Erigeron glabellus	0.02	0.87	4.35
Bidens frondosa	0.02	0.87	4.35
Lonicera dioica	0.02	0.87	4.35
Monarda fistulosa	0.02	0.87	4.35
Muhlenbergia richardsonis	0.02	0.87	4.35
Pedicularis lanceolata	0.02	0.87	4.35
Petasites sagittatus	0.02	0.87	4.35
Prunus virginiana	0.02	0.87	4.35
Rubus pubescens	0.01	12.17	30.43
Agoseris glauca	0	0.04	4.35
Artemesia ludoviciana	0	0.04	4.35
Elaeagnus commutata	0	0.04	4.35
Erigeron philadelphicus	0	0.04	4.35
Lilium philadelphicum	0	0.04	4.35
Lobelia kalmii	0	0.04	4.35
Polygala senega	0	0.04	4.35

Table 8. Grassland shrub density, Gardenton PFRA Community Pasture, sampled July - August 1997 (n = 28 quadrats).

Species	Mean density (stems/5 m x 5 m)	Mean density (stems/ha)
Populus tremuloides	7	2,800
Salix petiolaris	3	1,200
Corylus cornuta	1.5	600
Quercus macrocarpa	1.25	500
Salix bebbiana	0.5	200
Prunus virginiana	0.25	100

Table 9. Mean cover and frequency of grassland ground stratum, Gardenton PFRA Community Pasture, sampled July-August 1997 (n = 140 quadrats from 28 plots). Ground stratum consists of herbaceous species plus woody species (shrubs and trees) less than 1 m in height.

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Andropogon gerardii	24.18	50	60.71
Agrostis stolonifera	14.77	66.43	89.29
Calamagrostis inexpansa	6.34	44.29	75
Deschampsia caespitosa	5.64	35.71	57.14
Carex lanuginosa	4.99	25.71	53.57
Eleocharis spp.	4.97	31.43	53.57
Poa spp.	4.69	28.57	60.71
Spartina pectinata	4.65	35.71	71.43
Trifolium repens	4.42	18.61	35.71
Galium boreale	4.34	42.14	78.57
Salix petiolaris	4.06	20.11	53.57
Potentilla anserina	3.48	22.14	35.71
Carex buxbaumii	2.64	19.29	25
Juncus balticus	2.57	25.75	67.86
Fragaria virginiana	2.56	21.46	39.29
Achillea millefolium	2.05	20.07	64.29
Trifolium pratense	2.04	8.61	21.43
Populus tremuloides	1.95	9.32	17.86
Viola nephrophylla	1.93	15	28.57
Carex praegracilis	1.88	19.29	42.86
Agropyron trachycaulum	1.82	15.71	35.71
Rosa acicularis	1.62	16.43	35.71
Glycyrrhiza lepidota	1.6	7.86	14.29
Solidago rigida	1.44	17.14	42.86
Hierochloe odorata	1.42	12.14	39.29
Sonchus arvensis	1.26	17.14	42.86
Juncus nodosus	1.13	11.46	35.71
Aster ericoides	1.09	20	53.57
Rhus radicans	1.09	2.86	3.57
Bromus inermis	1.06	6.43	10.71
Carex sartwellii	1	7.86	14.29
Antennaria spp.	0.89	3.57	14.29
Aster puniceus	0.85	11.46	35.71
Solidago nemoralis	0.83	10.75	35.71
Panicum virgatum	0.81	10	21.43

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Potentilla fruticosa	0.8	13	35.71
Viola spp.	0.79	9.32	28.57
Carex brevior	0.7	5.75	17.86
Muhlenbergia asperifolia	0.69	6.46	17.86
Thalictrum dasycarpum	0.66	7.86	14.29
Prunella vulgaris	0.64	7.14	21.43
Stachys palustris	0.63	6.43	21.43
Hordeum jubatum	0.62	5.82	21.43
Aster ciliolatus	0.6	9.29	28.57
Aster laevis	0.57	7.89	25
Quercus macrocarpa	0.57	1.54	17.86
Anemone canadensis	0.53	5.82	17.86
Lathyrus palustris	0.51	5.71	14.29
Mentha arvensis	0.5	5	7.14
Phleum pratense	0.5	5	14.29
Rudbeckia hirta	0.48	7.93	39.29
Carex crawei	0.48	4.29	10.71
Senecio aureus	0.48	7.86	21.43
Spiraea alba	0.46	3.57	10.71
Equisetum hyemale	0.45	14.29	25
Medicago lupulina	0.44	2.86	3.57
Polygonum amphibium	0.44	2.86	3.57
Lycopus americanus	0.44	10	28.57
Petalostemum purpureum	0.4	5	17.86
Solidago canadensis	0.4	5	14.29
Agropyron smithii	0.37	3.57	7.14
Aster ptarmicoides	0.37	3.57	3.57
Carex aurea	0.37	3.57	14.29
Salix lutea	0.35	2.85	7.14
Melilotus alba	0.29	4.29	10.71
Salix bebbiana	0.27	0.71	3.57
Juncus dudleyi	0.24	2.14	3.57
Ranunculus cymbalaria	0.24	2.14	7.14
Juncus compressus	0.22	1.43	3.57
Apocynum cannabinum	0.2	4.29	14.29
Crepis tectorum	0.2	7.89	25
Erigeron strigosus	0.16	2.86	7.14
Melilotus officinalis	0.16	2.86	7.14
Steironema ciliatum	0.16	2.86	10.71

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Vicia americana	0.16	2.86	7.14
Parnassia palustris	0.16	2.86	3.57
Hypoxis hirsuta	0.16	6.43	17.86
Anemone cylindrica	0.15	2.14	3.57
Koeleria cristata	0.15	2.14	7.14
Plantago major	0.15	2.14	3.57
Solidago graminifolia	0.15	2.14	7.14
Lobelia kalmii	0.14	5.14	28.57
Zizia aurea	0.13	1.46	10.71
Bidens frondosa	0.13	1.43	3.57
Helianthus laetiflorus	0.13	1.43	7.14
Populus balsamifera	0.13	1.43	3.57
Corylus cornuta	0.11	0.75	7.14
Juncus torreyi	0.11	0.75	7.14
Amelanchier alnifolia	0.11	2.14	3.57
Carex spp.	0.11	0.71	3.57
Cicuta maculata	0.11	0.71	3.57
Gerardia purpurea	0.11	0.71	3.57
Maianthemum canadense	0.11	0.71	3.57
Zigadenus elegans	0.11	4.32	21.43
Campanula rotundifolia	0.08	2.89	14.29
Bromus ciliatus	0.07	2.86	7.14
Agoseris glauca	0.06	2.18	10.71
Taraxacum officinale	0.06	2.18	14.29
Alisma plantago-aquatica	0.05	2.14	3.57
Erigeron glabellus	0.05	2.86	7.14
Cirsium arvense	0.04	1.5	10.71
Monarda fistulosa	0.04	1.46	7.14
Smilax herbacea	0.04	1.46	7.14
Asclepias incarnata	0.04	1.43	3.57
Comandra umbellata	0.04	1.43	7.14
Lilium philadelphicum	0.04	1.43	7.14
Muhlenbergia richardsonis	0.04	1.43	7.14
Cornus stolonifera	0.02	0.75	7.14
Sisyrinchium montanum	0.02	0.75	7.14
Anemone quinquefolia	0.02	0.71	3.57
Equisetum arvense	0.02	0.71	3.57
Zizia aptera	0.02	0.71	3.57
Asclepias ovalifolia	0.01	0.11	10.71

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Betula pumila	0	0.04	3.57
Crataegus rotundifolia	0	0.04	3.57
Fraxinus pennsylvanica	0	0.04	3.57
Gentiana andrewsii	0	0.04	3.57
Juncus alpinus	0	0.04	3.57
Liastris ligulistylis	0	0.04	3.57
Pedicularis lanceolata	0	0.04	3.57
Prunus virginiana	0	0.04	3.57
Ribes oxyacanthoides	0	0.04	3.57

Table 10. Sedge meadow shrub density, Gardenton PFRA Community Pasture, sampled July - August 1997 (n = 18 quadrats).

Species	Mean density (stems/5 m x 5 m)	Mean density (stems/ha)
Salix petiolaris	17	6,800
Salix bebbiana	2.7	1,080
Betula pumila	2	800
Populus tremuloides	1.5	600
Salix lutea	1.2	480
Cornus stolonifera	0.6	240
Salix discolor	0.6	240
Salix lucida	0.6	240

Table 11. Mean cover and frequency of sedge meadow ground stratum, Gardenton PFRA Community Pasture, sampled July-August 1997 (n = 90 quadrats from 18 plots). Ground stratum consists of herbaceous species plus woody species (shrubs and trees) less than 1 m in height.

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Carex lanuginosa	16.88	68.89	83.33
Eleocharis spp.	15.34	71.11	83.33
Carex buxbaumii	13.91	72.22	83.33
Spartina pectinata	11.04	58.89	83.33
Salix petiolaris	9.89	32.28	66.67
Juncus balticus	8.49	55.56	72.22
Calamagrostis inexpansa	6.23	46.67	72.22
Mentha arvensis	6.17	25.56	38.89
Carex lasiocarpa	4.46	18.89	27.78
Deschampsia caespitosa	3.41	30	66.67
Juncus nodosus	2.69	11.17	22.22
Lycopus americanus	2.17	25.56	50
Solidago graminifolia	2.04	23.44	55.56
Agrostis stolonifera	1.97	8.89	11.11
Salix bebbiana	1.93	6.67	22.22
Potentilla anserina	1.91	26.67	55.56
Betula pumila	1.81	11.11	16.67
Rosa acicularis	1.79	15.61	38.89
Juncus alpinus	1.52	14.44	44.44
Fragaria virginiana	1.41	10	22.22
Carex rostrata	1.21	4.44	5.56
Carex sartwellii	1.2	13.33	38.89
Carex praegracilis	1.18	8.89	16.67
Steironema quadriflorum	1.12	10.06	27.78
Campanula aparinoides	1.06	7.78	11.11
Viola nephrophylla	1.02	7.78	11.11
Stachys palustris	1.01	11.17	27.78
Utricularia vulgaris	1.01	3.33	11.11
Cornus stolonifera	0.86	3.33	5.56
Calamagrostis canadensis	0.74	6.67	16.67
Asclepias incarnata	0.71	11.11	16.67
Cicuta maculata	0.69	1.11	5.56
Aster puniceus	0.62	13.33	38.89
Lemna minor	0.6	6.67	11.11
Polygonum amphibium	0.6	6.67	11.11

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Galium boreale	0.54	10	27.78
Lathyrus palustris	0.51	8.89	33.33
Potentilla fruticosa	0.49	7.83	27.78
Agropyron trachycaulum	0.4	4.44	5.56
Aster ptarmicoides	0.4	4.44	11.11
Juncus dudleyi	0.37	3.33	11.11
Triglochin maritima	0.37	3.33	5.56
Gentiana andrewsii	0.34	2.22	5.56
Alisma plantago-aquatica	0.32	6.78	33.33
Lobelia kalmii	0.29	5.61	16.67
Populus tremuloides	0.29	5.61	27.78
Solidago nemoralis	0.28	5.56	11.11
Apocynum cannabinum	0.28	11.11	33.33
Senecio aureus	0.26	4.44	16.67
Solidago canadensis	0.26	4.44	11.11
Solidago riddellii	0.26	4.44	11.11
Spiraea alba	0.23	3.39	16.67
Anemone canadensis	0.23	3.33	11.11
Carex aurea	0.23	3.33	11.11
Dracocephalum virginianum	0.23	3.33	11.11
Sium suave	0.23	3.33	11.11
Andropogon gerardii	0.2	2.22	5.56
Asclepias ovalifolia	0.2	2.22	5.56
Bromus inermis	0.2	2.22	5.56
Alnus rugosa	0.17	1.39	5.56
Panicum virgatum	0.17	1.11	5.56
Spiranthes romanzoffiana	0.17	1.11	5.56
Zizia aurea	0.17	6.67	11.11
Eriophorum spp.	0.08	3.33	11.11
Gerardia purpurea	0.08	3.33	5.56
Juncus torreyi	0.06	2.28	11.11
Achillea millefolium	0.06	2.22	11.11
Aster ericoides	0.06	2.22	11.11
Helianthus laetiflorus	0.04	1.22	16.67
Pedicularis lanceolata	0.04	1.22	16.67
Acorus calamus	0.03	1.17	11.11
Aster novae-angliae	0.03	1.11	5.56
Poa spp.	0.03	1.11	5.56
Ribes oxyacanthoides	0.03	1.11	5.56

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Salix lutea	0.03	1.11	5.56
Thalictrum dasycarpum	0.03	1.11	5.56
Juncus compressus	0.01	0.06	5.56
Lysimachia thyrsiflora	0.01	0.06	5.56

Table 12. Mean cover and frequency of marsh ground stratum, Gardenton PFRA Community Pasture, sampled July-August 1997 (n = 90 quadrats from 18 plots). Ground stratum consists of herbaceous species plus woody species (shrubs and trees) less than 1 m in height.

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Carex lasiocarpa	32.96	74.44	83.33
Utricularia vulgaris	17.5	53.33	72.22
Typha latifolia	12.84	36.67	66.67
Potamogeton gramineus	9.49	44.44	61.11
Carex rostrata	7.31	26.67	38.89
Lemna minor	7.23	20	27.78
Carex aquatilis	6.69	33.33	44.44
Carex buxbaumii	5.82	15.56	22.22
Polygonum amphibium	4.99	45.56	77.78
Carex lanuginosa	4.26	28.89	38.89
Juncus nodosus	2.46	5.56	11.11
Carex sartwellii	2.14	22.22	50
Scirpus lacustris	1.93	16.83	50
Spartina pectinata	1.51	10	16.67
Eleocharis spp.	1.48	18.89	33.33
Calamagrostis inexpansa	1.39	11.11	22.22
Mentha arvensis	1.28	6.72	22.22
Calamagrostis canadensis	1.27	7.83	33.33
Campanula aparinoides	1.15	2.28	16.67
Juncus balticus	1.14	16.67	27.78
Triglochin maritima	1.07	10	22.22
Lysimachia thyrsiflora	0.94	8.89	11.11
Potentilla anserina	0.72	5.56	11.11
Aster puniceus	0.71	11.11	22.22
Deschampsia caespitosa	0.6	6.67	16.67
Salix petiolaris	0.56	4.61	27.78
Asclepias incarnata	0.51	8.89	38.89
Eriophorum spp.	0.39	10	22.22
Lycopus americanus	0.28	5.56	5.56
Steironema ciliatum	0.28	5.56	11.11
Juncus alpinus	0.23	3.33	11.11
Betula pumila	0.2	2.22	5.56
Stachys palustris	0.2	2.22	5.56
Phragmites australis	0.18	1.17	11.11
Potentilla fruticosa	0.17	1.11	5.56
Salix bebbiana	0.17	1.11	5.56

Species	Mean Cover (%)	Frequency (%) (1 m x 1 m quadrats)	Frequency (%) (10 m x 10 m plots)
Equisetum hyemale	0.14	5.56	11.11
Sium suave	0.06	2.22	11.11
Alisma plantago-aquatica	0.03	1.11	5.56
Lobelia kalmii	0.03	1.11	5.56
Lonicera dioica	0.03	1.11	5.56
Spiraea alba	0.03	1.11	5.56
Viola spp.	0.03	1.11	5.56
Steironema quadriflorum	0.01	0.06	5.56

Terrestrial Vertebrates and Butterflies

Seventy-two bird species were recorded during point counts. Of these species, 34 were observed in the grassland habitats surveyed, compared with 23 in the aspen woodland and 47 in edge habitats (Table 13). Five additional species were observed outside of point count sites, bringing the total number of bird species seen to 77 (Appendix G). In the grassland habitat, the species encountered most frequently (i.e. in the most plots) were American Crow, Chipping Sparrow, Clay-coloured Sparrow, Killdeer and Red-winged Blackbird (Table 13). In the edge habitat, the most frequently encountered species were Clay-coloured Sparrow, Song Sparrow, Nashville Warbler, Common Yellowthroat and Chipping Sparrow. In the aspen woodland habitat, the most frequent species were Veery, Warbling Vireo, Tennessee Warbler, Ovenbird and Rose-breasted Grosbeak.

Often, the most frequently encountered bird species in each habitat type were also the most abundant birds (Table 14). Chipping Sparrow, Clay-coloured Sparrow, Killdeer, Black Tern and Savannah Sparrow were the most abundant birds in the grassland habitat. Clay-coloured Sparrow, Song Sparrow, Common Yellowthroat, American Crow and Chipping Sparrow were found in highest numbers in the edge habitat. Ovenbird, Veery, American Redstart, Warbling Vireo and Rose-breasted Grosbeak were the most abundant species in the aspen woodland habitat.

The three habitat types displayed the reverse trend in terms of bird species abundance, as measured by the number of birds recorded over the three days of listening (Table 14). Aspen woodland sites had the highest number of birds recorded, despite having the lowest species richness. Conversely, edge habitats contained the fewest birds, despite having the highest species richness.

Small mammal trapping consisted of 270 trap nights in each habitat type (90 trap nights in each of the three sampling areas). Forty mammals were collected during small mammal trapping, representing four species (Table 15). Four non-target species were also accidentally trapped, including a Leopard Frog in the grassland habitat and a Wood Frog, Clay-coloured Sparrow and Ruffed Grouse in the aspen woodland habitat. The most abundant small mammal species in the grassland habitat type were Meadow Vole, Thirteen-lined Ground Squirrel and Meadow Jumping Mouse. Red-backed Vole, Meadow Jumping Mouse and Meadow Vole were most abundant in edge habitat, and Red-backed Vole, Meadow Vole and Meadow Jumping Mouse in aspen woodland habitat.

Observations of reptiles, amphibians and butterflies, as well as additional bird and mammal species observed outside of the sampling area, resulted in a final species list of 101 species. In total, 11 mammal species (Appendix D), 77 bird species (Appendix G), and two reptile and five amphibian species (Appendix E) were observed in the Gardenton PFRA Community Pasture during the study period. Six butterfly species (Appendix F) are also included, of which all were common and highly visible throughout the pasture. A "Relative Abundance" category was also developed based on Cleveland et al. (1988). Relative abundance estimations ranged from *abundant* (as species detected on most visits in preferred habitat during the study period) to *occasional* (as species seen one time only during the study period).

Table 13. Bird species abundance and frequency in aspen habitat, Gardenton PFRA Community Pasture point counts, July - August 1997. Abundance summarized by the mean number of birds/point/sampling day (n = 4 points/sampling area x 3 sampling areas x 3 days). Frequency summarized by the number of times (out of a total of 12 point count sites) a species was encountered.

Birds in aspen habitat	Number of birds counted	Mean number of birds per site per day	No. of point count sites bird was encountered
Ovenbird	34	0.94	9
Veery	31	0.86	10
American Redstart	23	0.64	10
Warbling Vireo	20	0.56	9
Rose-breasted Grosbeak	19	0.53	9
Red-eyed Vireo	18	0.5	7
Northern Flicker	15	0.42	6
Tennessee Warbler	14	0.39	9
Black-capped Chickadee	11	0.31	7
American Robin	10	0.28	6
Hairy Woodpecker	8	0.22	5
White-breasted Nuthatch	7	0.19	6
Eastern Phoebe	6	0.17	3
Blue Jay	5	0.14	5
Mourning Dove	5	0.14	3
American Crow	4	0.11	2
Downy Woodpecker	3	0.08	2
Brown Creeper	3	0.08	3
Yellow-bellied Sapsucker	2	0.06	2
Chestnut-sided Warbler	2	0.06	2
Black-and-white Warbler	1	0.03	1
Wood Thrush	1	0.03	1
Dark-eyed Junco	1	0.03	1
Total	**243**	**6.75**	

Table 14. Bird species abundance and frequency in grassland habitat, Gardenton PFRA Community Pasture point counts, July - August 1997. Abundance summarized by the mean number of birds/point/sampling day (n = 4 points/sampling area x 3 sampling areas x 3 days). Frequency summarized by the number of times (out of a total of 12 point count sites) a species was encountered.

Birds in grassland habitat	Number of birds counted	Mean number of birds per site per day	No. of point count sites bird was encountered
Chipping Sparrow	25	0.69	8
Clay-coloured Sparrow	25	0.69	8
Killdeer	16	0.44	7
Black Tern	14	0.39	2
Savannah Sparrow	14	0.39	4
American Crow	13	0.36	8
Marsh Wren	13	0.36	6
Red-winged Blackbird	13	0.36	7
Common Snipe	12	0.33	3
Western Meadowlark	9	0.25	6
Vesper Sparrow	8	0.22	4
Barn Swallow	6	0.17	3
American Robin	6	0.17	5
Yellow Warbler	6	0.17	3
Mourning Dove	5	0.14	4
Sandhill Crane	4	0.11	3
Song Sparrow	4	0.11	2
House Sparrow	4	0.11	2
Marbled Godwit	3	0.08	3
Sedge Wren	3	0.08	2
European Starling	3	0.08	2
Yellow-headed Blackbird	3	0.08	3
Brown-headed Cowbird	3	0.08	3
Horned Lark	2	0.06	2
Swamp Sparrow	2	0.06	1
Sora	1	0.03	1
Upland Sandpiper	1	0.03	1
Wilson's Phalarope	1	0.03	1
Ring-billed Gull	1	0.03	1
Eastern Kingbird	1	0.03	1
Eastern Bluebird	1	0.03	1
Bobolink	1	0.03	1
Brewer's Blackbird	1	0.03	1
American Goldfinch	1	0.03	1
Total	**225**	**6.25**	

Table 15. Bird species abundance and frequency in edge habitat, Gardenton PFRA Community Pasture point counts, July - August 1997. Abundance summarized by the mean number of birds/point/sampling day (n = 4 points/sampling area x 3 sampling areas x 3 days). Frequency summarized by the number of times (out of a total of 12 point count sites) a species was encountered.

Birds in edge habitat	Number of birds counted	Mean number of birds per site per day	No. of point count sites bird was encountered
Clay-coloured Sparrow	23	0.64	10
Song Sparrow	17	0.47	8
Common Yellowthroat	14	0.39	7
American Crow	12	0.33	6
Chipping Sparrow	12	0.33	7
Vesper Sparrow	11	0.31	5
American Goldfinch	9	0.25	6
Nashville Warbler	8	0.22	7
American Robin	6	0.17	6
Red-winged Blackbird	6	0.17	4
Black-capped Chickadee	5	0.14	5
Yellow Warbler	5	0.14	4
Lark Sparrow	5	0.14	4
Northern Flicker	4	0.11	1
Least Flycatcher	4	0.11	4
House Wren	4	0.11	3
Western Meadowlark	4	0.11	3
Killdeer	3	0.08	2
Mourning Dove	3	0.08	3
Eastern Phoebe	3	0.08	2
Eastern Kingbird	3	0.08	2
Black-billed Magpie	3	0.08	2
Marsh Wren	3	0.08	1
Le Conte's Sparrow	3	0.08	2
Brown-headed Cowbird	3	0.08	3
Red-tailed Hawk	2	0.06	1
Blue Jay	2	0.06	2
Gray Catbird	2	0.06	2
Cedar Waxwing	2	0.06	1
Canada Warbler	2	0.06	2
Rufous-sided Towhee	2	0.06	2
Savannah Sparrow	2	0.06	1
Common Grackle	2	0.06	2
Northern Oriole	2	0.06	2
Sandhill Crane	1	0.03	1
Common Snipe	1	0.03	1
Ring-billed Gull	1	0.03	1
Downy Woodpecker	1	0.03	1
Alder Flycatcher	1	0.03	1
Western Kingbird	1	0.03	1
Tree Swallow	1	0.03	1
Sedge Wren	1	0.03	1
Eastern Bluebird	1	0.03	1
Rose-breasted Grosbeak	1	0.03	1
White-throated Sparrow	1	0.03	1

Brewer's Blackbird	1	0.03	1
House Sparrow	1	0.03	1
Total	**204**	**5.71**	

Table 16. Small mammal snap trap results, Gardenton PFRA Community Pasture, 1997 (n = 270 trap nights per habitat type).

	Grassland	Edge	Aspen	Total
Mammals:				
Red-backed Vole	0	3	19	22
Meadow Vole	8	1	4	13
Meadow Jumping Mouse	1	1	2	4
Thirteen-lined Ground Squirrel	1	0	0	1
Total Mammals	10	5	25	40
Other species:				
Leopard Frog	1	0	0	1
Wood Frog	0	0	1	1
Ruffed Grouse	0	0	1	1
Clay-coloured Sparrow	0	0	1	1
Total other species	1	0	3	4
Grand Total	**11**	**5**	**28**	**44**

Carabid Beetles

Specimens of adult carabid beetles collected and identified as part of this study totalled 929, representing 68 species in 24 genera. Two large genera, *Agonum* Bonelli and *Pterostichus* Bonelli dominated the carabid fauna of the Gardenton Community Pasture. Together, these genera accounted for over 50 per cent of the total carabid beetles collected. Other common genera were *Chlaenius* Bonelli, *Poecilus* Bonelli, *Carabus* Linnaeus, and *Bembidion* Latreille, representing 9.7, 7.2, 7.0, and 5.4 per cent of the total catch, respectively (Table 16).

The most abundant species at the Gardenton Community Pasture was *Agonum cupripenne* (Say), with 129 specimens collected over a ten-week period. The most common species were collected throughout the entire field season. Some species were more common early in the field season (*Agonum gratiosum* (Mannerheim), for example), and some increased in abundance later in the season (e.g. *Chaenius s. sericeus*) (Table 17).

Agonum cupripenne was the most abundant species in pitfall traps PF 1 through PF 20. Traps PF 21-25 and PF 36-45 were dominated by *A. cupreum* Dejean. *A. errans* (Say) and *A. gratiosum* (Mannerheim) were most abundant in traps PF 56-60 and FIT 3-4 respectively. Other common species were *Synchus impunctatus* (PF 26-30), *Bembidion patruele* Dejean (FIT 1-2), *Pterostichus commutabilis* (Mots.) (PF 31-35 and PF 51-55), and *Poecilus lucublandus* (PF 31-35 and PF 46-50) (Table 18).

The most productive pitfall traps were PF 55-60, which collected 170 specimens or 3.4 carabids for each sampling period per individual trap. The least productive were PF 31-35, which collected only 18 specimens or an average of 0.4 carabids for each sampling period per individual trap (Table 19).

Table 20 lists the 53 carabid species collected at St. Charles Rifle Range (compare to Table 17 from the Gardenton Community Pasture). Many species occurred at both sites with variation in relative abundance. *Poecilus lucublandus*, *Syntomus americanus* (Dejean), and *Pterostichus femoralis* (Kirby) accounted for 68 per cent of the relative abundance of beetles on the Rifle Range; these same species accounted for only 8.5 per cent of relative abundance on the Community Pasture.

Most of the species collected at the Gardenton Community Pasture were widespread across Canada (Bousquet 1991), with several exceptions. For example, *Anisodactylus pitychrous* LeConte, *Bembidion nudipenne* Lindroth, and *B. obtusangulum* LeConte reached their eastern range extent in Manitoba, while Manitoba was the western extent for the range of *Pterostichus novus* Straneo. *Bembidion praticola* Lindroth was recorded from Manitoba for the first time and several rare species were collected (Table 21).

Table 17. Relative abundance of genera of Carabidae collected on Gardenton PFRA Community Pasture, July - September 1997, with number of species and number of specimens collected for each genus.

Genus	# of species	# of specimens	% of total
Agonum	9	330	35.5%
Pterostichus	9	170	18.3%
Chlaenius	4	90	9.7%
Poecilus	1	67	7.2%
Carabus	1	65	7.0%
Bembidion	14	50	5.4%
Dyschirius	2	26	2.8%
Harpalus	2	23	2.5%
Amara	6	21	2.3%
Synuchus	1	20	2.2%
Oxypselaphus	1	14	1.5%
Platynus	1	8	0.9%
Acupalpus	1	6	0.6%
Elaphropus	2	6	0.6%
Stenolophus	1	6	0.6%
Diplocheila	2	5	0.5%
Anisodactylus	2	4	0.4%
Loricera	1	4	0.4%
Syntomus	1	4	0.4%
Cymindis	2	3	0.3%
Patrobus	2	3	0.3%
Notiophilus	1	2	0.2%
Calosoma	1	1	0.1%
Elaphrus	1	1	0.1%
Total	**68**	**929**	

Table 18. Species totals of Carabidae collected on Gardenton PFRA Community Pasture, July - September 1997, by decreasing relative abundance. Each collecting period is one week long, with the first collecting period beginning July 7, 1997.

Collecting period	1	2	3	4	5	6	7	8	9	10	Total	Percent
Agonum cupripenne (Say)	4	23	19	22	10	5	8	11	14	13	129	13.9%
Agonum cupreum Dejean	3	12	7	8	5	4	4	18	13	16	90	9.7%
Poecilus lucublandus (Say)	19	13	7	2	1	1	3	7	7	7	67	7.2%
Carabus m. meander Fischer	10	15	1	6	7	0	8	4	5	9	65	7.0%
Agonum errans (Say)	1	2	9	15	16	1	3	5	6	6	64	6.9%
Chlaenius s. sericeus (Forster)	3	3	3	3	5	0	8	9	12	14	60	6.5%
Pterostichus commutabilis (Mots.)	12	19	8	5	3	3	5	1	2	2	60	6.5%
Pterostichus melanarius (Illiger)	0	2	1	10	11	8	9	9	7	1	58	6.2%
Agonum gratiosum (Mannerheim)	11	11	4	5	3	0	0	0	0	0	34	3.7%
Chlaenius alternatus Horn	1	3	0	2	0	1	4	4	5	2	22	2.4%
Harpalus pensylvanicus (DeGeer)	1	1	0	1	4	3	8	3	1	0	22	2.4%
Pterostichus novus Straneo	3	1	2	4	7	0	2	1	1	0	21	2.3%
Synuchus impunctatus (Say)	0	1	2	0	1	2	6	4	3	1	20	2.2%
Bembidion patruele Dejean	14	1	2	0	0	0	0	0	0	0	17	1.8%
Dyschirius sphaericollis (Say)	1	2	0	7	4	1	0	0	0	0	15	1.6%
Oxypselaphus puncticeps (Casey)	5	6	1	1	0	0	0	1	0	0	14	1.5%
Amara angustata (Say)	1	6	4	2	0	0	0	0	0	0	13	1.4%
Pterostichus corvinus (Dejean)	4	5	1	0	1	0	1	0	0	1	13	1.4%
Dyschirius setosus LeConte	4	2	1	3	1	0	0	0	0	0	11	1.2%
Platynus decentis (Say)	7	0	1	0	0	0	0	0	0	0	8	0.9%
Pterostichus femoralis (Kirby)	4	3	1	0	0	0	0	0	0	0	8	0.9%
Agonum corvus (LeConte)	0	0	0	0	0	0	1	0	4	2	7	0.8%
Chlaenius p. pennsylvanicus Say	0	0	0	0	0	0	0	2	4	1	7	0.8%
Acupalpus carus (LeConte)	0	4	1	1	0	0	0	0	0	0	6	0.6%
Bembidion versicolor (LeConte)	0	0	0	0	5	0	0	1	0	0	6	0.6%
Pterostichus pensylvanicus LeConte	3	3	0	0	0	0	0	0	0	0	6	0.6%
Stenolophus ochropezus (Say)	0	0	0	1	0	3	1	1	0	0	6	0.6%
Bembidion mimus Hayward	1	2	1	1	0	0	0	0	0	0	5	0.5%
Bembidion mutatum G. & H.	2	2	0	0	1	0	0	0	0	0	5	0.5%
Elaphropus incurvus (Say)	2	1	0	1	0	0	0	1	0	0	5	0.5%
Amara torrida (Panzer)	0	0	0	0	1	1	0	2	0	0	4	0.4%
Diplocheila striatopunctata LeConte	0	1	0	0	0	0	0	0	0	3	4	0.4%
Loricera p. pilicornis (Fabricius)	0	0	0	0	1	0	1	1	0	1	4	0.4%
Syntomus americanus (Dejean)	1	1	1	1	0	0	0	0	0	0	4	0.4%
Agonum melanarium Dejean	0	0	0	0	0	0	0	3	0	0	3	0.3%
Anisodactylus harrisii LeConte	0	1	2	0	0	0	0	0	0	0	3	0.3%
Bembidion canadianum Casey	1	1	1	0	0	0	0	0	0	0	3	0.3%
Bembidion aeneicolle (LeConte)	0	0	0	2	0	0	0	0	0	0	2	0.2%

Collecting period	1	2	3	4	5	6	7	8	9	10	Total	Percent
Bembidion bimaculatum (Kirby)	0	0	0	1	0	0	0	0	1	0	2	0.2%
Bembidion concretum Casey	1	1	0	0	0	0	0	0	0	0	2	0.2%
Bembidion nigripes (Kirby)	1	0	1	0	0	0	0	0	0	0	2	0.2%
Bembidion praticola Lindroth	1	1	0	0	0	0	0	0	0	0	2	0.2%
Cymindis cribricollis Dejean	0	0	0	0	1	0	0	1	0	0	2	0.2%
Notiophilus semistriatus Say	0	1	0	0	0	1	0	0	0	0	2	0.2%
Patrobus LeContei Chaudoir	0	0	0	0	0	0	0	0	1	1	2	0.2%
Pterostichus mutus (Say)	1	1	0	0	0	0	0	0	0	0	2	0.2%
Agonum placidum (Say)	0	0	0	0	0	0	0	0	1	0	1	0.1%
Agonum propinquum (G. & H.)	0	0	1	0	0	0	0	0	0	0	1	0.1%
Agonum trigeminum Lindroth	0	0	0	0	1	0	0	0	0	0	1	0.1%
Amara avida (Say)	0	0	0	1	0	0	0	0	0	0	1	0.1%
Amara cupreolata Putzeys	0	0	0	0	1	0	0	0	0	0	1	0.1%
Amara lacustris (?) LeConte	0	0	0	0	1	0	0	0	0	0	1	0.1%
Amara lunicollis Schiodte	0	1	0	0	0	0	0	0	0	0	1	0.1%
Anisodactylus pitychrous LeConte	0	0	0	0	0	0	0	1	0	0	1	0.1%
Bembidion muscicola Hayward	1	0	0	0	0	0	0	0	0	0	1	0.1%
Bembidion nudipenne Lindroth	0	0	1	0	0	0	0	0	0	0	1	0.1%
Bembidion obtusangulum LeConte	0	0	0	0	0	0	0	1	0	0	1	0.1%
Bembidion transparens (Gebler)	0	1	0	0	0	0	0	0	0	0	1	0.1%
Calosoma calidum (Fabricius)	0	1	0	0	0	0	0	0	0	0	1	0.1%
Chlaenius l. lithophilus Say	0	0	0	0	0	0	1	0	0	0	1	0.1%
Cymindis neglecta Haldeman	0	1	0	0	0	0	0	0	0	0	1	0.1%
Diplocheila undulata Carr	0	1	0	0	0	0	0	0	0	0	1	0.1%
Elaphropus vernicatus (Casey)	1	0	0	0	0	0	0	0	0	0	1	0.1%
Elaphrus fuliginosus Say	0	0	0	0	1	0	0	0	0	0	1	0.1%
Harpalus somnulentus Dejean	0	0	1	0	0	0	0	0	0	0	1	0.1%
Patrobus longicornis (Say)	0	0	0	1	0	0	0	0	0	0	1	0.1%
Pterostichus caudicalis (Say)	0	0	0	1	0	0	0	0	0	0	1	0.1%
Pterostichus luctuosus (Dejean)	1	0	0	0	0	0	0	0	0	0	1	0.1%
											Total: 929	

Table 19. Species totals of Carabidae collected on Gardenton PFRA Community Pasture, July - September 1997, arranged by relative abundance and by trap series.

	Trap Series												
	PF 1-5	PF 6-10	PF 11-20	PF 21-25	PF 26-30	PF 31-35	PF 36-40	PF 41-45	PF 46-50	PF 51-55	PF 56-60	FITs 1-2	FITs 3-4
Agonum cupripenne (Say)	61	16	21	9				6	12		4		
Agonum cupreum Dejean	25	9	9	13			13	14	7				
Poecilus lucublandus (Say)	15	6	4	7	2	3	2	4	17	3	3	1	
Carabus m. meander Fischer	3	6	11	5		2	3	3	9	4	13	6	
Agonum errans (Say)	1	1							1	3	58		
Chlaenius s. sericeus (Forster)	3	3	7	1			6	1			39		
Pterostichus commutabilis (Mots.)	4	5	15	3		3	2	5	8	5	7	3	
Pterostichus melanarius (Illiger)	3	1	17	1	1		2	6	5	2	11	9	
Agonum gratiosum (Mannerheim)			5			2					2	5	20
Chlaenius alternatus Horn	1	2		1		2	4	1	2	1	3	4	1
Harpalus pensylvanicus (DeGeer)	5	2	4	2			1	3	4			1	
Pterostichus novus Straneo		1	6		1	1	2	1	1	1	4	2	1
Synuchus impunctatus (Say)			1		16								3
Bembidion patruele Dejean										1		16	
Dyschirius sphaericollis (Say)	4	6	1	4									
Oxypselaphus puncticeps (Casey)					1							4	9
Amara angustata (Say)			1		1	1						2	8
Pterostichus corvinus (Dejean)	1							1			9	1	1
Dyschirius setosus LeConte	3	1	1	1				1	1			3	
Platynus decentis (Say)												1	7
Pterostichus femoralis (Kirby)			1									4	3
Agonum corvus (LeConte)	1		4					1	1				
Chlaenius p. pennsylvanicus Say	1	1						1			4		
Acupalpus carus (LeConte)							1					3	2
Bembidion versicolor (LeConte)		1										5	

	PF 1-5	PF 6-10	PF 11-20	PF 21-25	PF 26-30	Trap PF 31-35	Series PF 36-40	PF 41-45	PF 46-50	PF 51-55	PF 56-60	FITs 1-2	FITs 3-4
Pterostichus pensylvanicus LeConte					4							1	1
Stenolophus ochropezus (Say)						1			1	2	2		
Bembidion mimus Hayward							1	1				3	
Bembidion mutatum G. & H.		1			1							1	2
Elaphropus incurvus (Say)	2			2							1		
Amara torrida (Panzer)				2		1					1		
Diplocheila striatopunctata LeConte							2			1	1		
Loricera p. pilicornis (Fabricius)	1		2								1		
Syntomus americanus (Dejean)												2	2
Agonum melanarium Dejean	2								1				
Anisodactylus harrisii LeConte				1								2	
Bembidion canadianum Casey												1	2
Bembidion aeneicolle (LeConte)										1	1		
Bembidion bimaculatum (Kirby)	2												
Bembidion concretum Casey												2	
Bembidion nigripes (Kirby)												2	
Bembidion praticola Lindroth						1				1			
Cymindis cribricollis Dejean					1								1
Notiophilus semistriatus Say				1								1	
Patrobus LeContei Chaudoir											2		
Pterostichus mutus (Say) ?						1			1				
Agonum placidum (Say)	1												
Agonum propinquum (G. & H.)											1		
Agonum trigeminum Lindroth					1								
Amara avida (Say)												1	
Amara cupreolata Putzeys					1								
Amara lacustris (?) LeConte				1									
Amara lunicollis Schoidte					1								

						Trap	Series						
	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	FITs	FITs
	1-5	6-10	11-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	1-2	3-4
Anisodactylus pitychrous LeConte		1											
Bembidion muscicola Hayward												1	
Bembidion nudipenne Lindroth													1
Bembidion obtusangulum LeConte				1									
Bembidion transparens (Gebler)												1	
Calosoma calidum (Fabricius)							1						
Chlaenius l. lithophilus Say											1		
Cymindis neglecta Haldeman													1
Diplocheila undulata Carr												1	
Elaphropus vernicatus (Casey)												1	
Elaphrus fuliginosus Say											1		
Harpalus somnulentus Dejean	1												
Patrobus longicornis (Say)													1
Pterostichus caudicalis (Say)											1		
Pterostichus luctuosus (Dejean)													1

Table 20. Total carabid beetles collected in the Gardenton Community Pasture by trap series. Specimens were collected over a 10-week period in the summer of 1997.

						Trap	Series						
	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	FITs	FITs
	1-5	6-10	11-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	1-2	3-4
Number of specimens	140	63	110	55	31	18	40	49	71	25	170	90	67
Number of species collected	21	17	17	17	12	11	13	15	15	12	23	31	19
Number of traps in series	5	5	10	5	5	5	5	5	5	5	5	2	2
Specimens/trap	28	12.6	11	11	6.2	3.6	8	9.8	14.2	5	34	45	33.5
Trapping efficiency (Specimens/trap/week)	2.8	1.26	1.1	1.1	0.62	0.36	0.8	0.98	1.42	0.5	3.4	4.5	3.35

Table 21. Species totals of Carabidae collected at St. Charles Rifle Range, Winnipeg, in 1997 in order of descending relative abundance. Each collecting period is one week long.

	Collecting period																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total	%
Poecilus lucublandus (Say)	60	75	54	94	47	40	10	5	1	1	6	10	35	96	92	96	169	46	28	7	4	0	0	976	32.78%
Syntomus americanus (Dejean)	118	75	41	80	29	90	92	40	35	12	3	8	13	9	16	8	13	13	15	12	4	19	4	749	25.16%
Pterostichus femoralis (Kirby)	10	10	12	6	2	2	3	2	1	11	7	6	7	4	16	18	25	36	49	27	29	20	6	309	10.38%
Calosoma calidum (Fabricius)	33	26	20	19	11	1	5	2	3	3	0	1	1	0	0	0	0	0	0	0	0	0	0	125	4.20%
Agonum cupreum Dejean	15	9	6	5	5	21	7	9	7	2	0	2	3	2	1	3	3	7	4	0	0	1	0	112	3.76%
Bembidion mutatum G. & H.	7	7	2	2	0	3	3	0	6	2	1	8	4	6	7	8	7	14	6	3	2	2	3	103	3.46%
Agonum placidum (Say)	5	5	4	4	3	1	0	2	0	1	0	0	6	8	11	8	12	8	4	4	1	1	0	88	2.96%
Pterostichus melanarius (Illiger)	0	0	1	0	0	0	1	10	5	5	3	7	20	14	7	4	5	5	1	0	0	0	0	88	2.96%
Cymindis planipennis LeConte	0	0	0	0	0	0	0	0	0	0	5	0	2	2	2	6	12	14	22	8	3	0	0	76	2.55%
Lebia divisa LeConte	0	0	0	0	0	1	0	1	0	0	1	1	0	5	5	16	10	9	11	0	0	0	0	60	2.02%
Harpalus pensylvanicus (DeGeer)	0	0	0	0	0	0	2	0	3	4	3	2	18	15	3	5	1	0	0	1	0	0	0	57	1.91%
Amara cupreolata Putzeys	9	1	3	5	0	3	4	0	1	1	0	0	0	1	1	1	1	1	0	0	0	0	0	32	1.07%
Agonum corvus LeConte	1	0	0	1	0	0	0	1	0	3	0	0	4	0	1	3	4	4	0	0	0	0	0	22	0.74%
Harpalus sommulentus Dejean	0	0	0	2	3	6	1	4	2	1	0	2	1	0	0	0	0	0	0	0	0	0	0	22	0.74%
Chlaenius purpuricollis Randall	3	4	0	3	0	0	0	0	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0	16	0.54%
Brachycellus congener (LeConte)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	5	15	0.50%
Pterostichus commutabilis (Mot.)	1	0	4	1	0	4	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	14	0.47%
Lebia atriventris Say	0	0	0	0	0	0	0	0	0	0	0	3	0	1	1	0	1	3	2	2	0	0	0	13	0.44%
Notiophilus semistriatus Say	0	0	0	0	0	0	0	0	2	1	0	0	2	1	1	2	2	0	0	0	0	1	0	12	0.40%
Pterostichus caudicalis (Say)	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	4	0	0	10	0.34%
Anisodactylus harrisi (LeConte)	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	6	0.20%
Amara apricaria (Paykull)	0	0	0	0	0	0	0	0	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	5	0.17%
Bembidion versicolor (LeConte)	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.17%
Synuchus impunctatus (Say)	0	0	0	0	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	5	0.17%
Cymindis cribricollis Dejean	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	4	0.13%
Pterostichus pensylvanicus LeC.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	4	0.13%
Amara latior (Kirby)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	3	0.10%
Amara obesa (Say)	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	3	0.10%
Chlaenius s. sericeus (Forster)	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.10%
Cymindis neglecta Haldeman	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	3	0.10%
Pterostichus corvinus (Dejean)	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.10%
Trichocellus cognatus (Gyll.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	3	0.10%
Acupalpus carus LeConte	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.07%
Agonum cupripenne (Say)	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.07%
Agonum gratiosum (Mann.)	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.07%
Anisodactylus sanctaecrucis (F.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0.07%
Bembidion q. oppositum Say	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0.07%
Dyschirius globulosus Say	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0.07%
Harpalus ?herbivagus Say	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2	0.07%
Harpalus indigens Casey	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0.07%

	Collecting period																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total	%
Notiophilus aquaticus (L.)	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.07%
Stenolophus comma (Fabr.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0.07%
Acupalpus canadensis Casey	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%
Badister transversus Casey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0.03%
Bembidion fortestriatum (Mot.)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%
Bembidion nitidum (Kirby)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.03%
Bradycellus neglectus (LeC.)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%
Chlaenius p. pensylvanicus Say	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%
Harpalus opacipennis Haldeman	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%
Harpalus ?paratus Casey	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%
Lebia vittata (Fabr.)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%
Patrobus stygicus Chaud.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%
Stenolophus conjunctus Say	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.03%

Table 22. Distribution of species of Carabidae collected on PFRA Gardenton Community Pasture, July - September 1997. Data are taken from Bousquet (1991). A "1" indicates presence of a species in a particular province, territory or state.

	AK	YK	NT	BC	AB	SK	MB	ON	PQ	NB	NS	PE	LB	NF	Notes
Acupalpus carus (LeConte)				1			1	1	1	1	1	1		1	
Agonum corvus (LeConte)				1	1	1	1	1	1						
Agonum cupreum Dejean	1		1	1	1	1	1	1	1	1					
Agonum cupripenne (Say)			1	1	1	1	1	1	1	1	1	1		1	
Agonum errans (Say)				1	1	1	1	1	1						
Agonum gratiosum (Mannerheim)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Agonum melanarium Dejean				1	1	1	1	1	1	1	1	1			
Agonum placidum (Say)				1	1	1	1	1	1	1	1	1	1	1	
Agonum propinquum (G. & H.)	1	1	1	1	1	1	1	1	1	1	1	1		1	
Agonum trigeminum Lindroth							1	1	1	1	1	1			
Amara angustata (Say)						1	1	1	1						
Amara avida (Say)				1	1	1	1	1	1	1	1	1		1	
Amara cupreolata Putzeys			1	1	1	1	1	1	1	1	1	1			
Amara lacustris (?) LeConte	1	1	1	1	1	1	1	1			1				
Amara lunicollis Schoidte	1	1	1	1	1	1	1	1	1	1	1		1	1	
Amara torrida (Panzer)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Anisodactylus harrisii LeConte				1	1	1	1	1	1		1				
Anisodactylus pitychrous LeConte					1	1	1								Rarely collected in Canada.
Bembidion aeneicolle (LeConte)			1	1	1	1	1								
Bembidion bimaculatum (Kirby)	1	1	1	1	1	1	1	1							
Bembidion canadianum Casey			1		1	1	1	1	1						Rarely collected in Canada.
Bembidion concretum Casey	1	1	1	1	1	1	1	1	1	1	1	1		1	
Bembidion mimus Hayward						1	1	1	1	1	1	1		1	
Bembidion muscicola Hayward						1	1	1	1	1	1	1			

	AK	YK	NT	BC	AB	SK	MB	ON	PQ	NB	NS	PE	LB	NF	Notes
Bembidion mutatum G. & H.	1	1	1	1	1	1	1	1	1		1			1	
Bembidion nigripes (Kirby)	1	1	1	1	1	1	1	1	1	1		1	1	1	
Bembidion nudipenne Lindroth					1	1	1								Rarely collected in Canada.
Bembidion obtusangulum LeConte				1	1	1	1								
Bembidion patruele Dejean			1	1	1	1	1	1	1	1	1	1		1	
Bembidion praticola Lindroth				1		1	1	1	1	1					New record for Manitoba.
Bembidion transparens (Gebler)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Bembidion versicolor (LeConte)	1		1	1	1	1	1	1	1	1	1	1	1	1	
Calosoma calidum (Fabricius)			1	1	1	1	1	1	1	1	1			1	
Carabus m. meander Fischer	1		1	1	1	1	1	1	1	1	1	1	1	1	
Chlaenius alternatus Horn	1		1	1	1	1	1	1	1	1	1			1	
Chlaenius l. lithophilus Say			1	1	1	1	1	1	1	1	1	1		1	
Chlaenius p. pennsylvanicus Say				1	1	1	1	1	1	1	1	1		1	
Chlaenius s. sericeus (Forster)				1	1	1	1	1	1	1	1	1		1	
Cymindis cribricollis Dejean		1	1	1	1	1	1	1	1	1	1		1	1	
Cymindis neglecta Haldeman					1	1	1	1	1	1					
Diplocheila striatopunctata LeConte			1	1	1	1	1	1	1						
Diplocheila undulata Carr					1		1								
Dyschirius setosus LeConte	1			1	1	1	1	1	1	1	1	1			
Dyschirius sphaericollis (Say)				1	1	1	1	1	1	1	1	1		1	
Elaphropus incurvus (Say)				1		1	1	1	1	1	1	1			
Elaphropus vernicatus (Casey)						1	1	1	1	1					
Elaphrus fuliginosus Say				1	1	1	1								Rarely collected in Canada.
Harpalus pensylvanicus (DeGeer)				1		1	1	1	1	1	1	1			
Harpalus somnulentus Dejean	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Loricera p. pilicornis (Fabricius)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Notiophilus semistriatus Say	1	1		1	1		1	1	1		1		1		

	AK	YK	NT	BC	AB	SK	MB	ON	PQ	NB	NS	PE	LB	NF	Notes
Oxypselaphus puncticeps (Casey)				1		1	1	1	1		1	1			
Patrobus LeContei Chaudoir				1	1	1	1		1	1				1	
Patrobus longicornis (Say)			1	1	1	1	1	1	1	1	1	1		1	
Platynus decentis (Say)	1		1	1	1	1	1	1	1	1	1	1	1	1	
Poecilus lucublandus (Say)			1	1	1	1	1	1	1	1	1	1			
Pterostichus caudicalis (Say)			1	1	1	1	1	1	1					1	
Pterostichus commutabilis (Mots.)				1		1	1	1	1	1	1				
Pterostichus corvinus (Dejean)			1	1	1	1	1	1	1	1					
Pterostichus femoralis (Kirby)					1	1	1	1	1						
Pterostichus luctuosus (Dejean)				1	1	1	1	1	1	1	1	1		1	
Pterostichus melanarius (Illiger)				1	1	1	1	1	1	1	1	1		1	
Pterostichus mutus (Say) ?				1			1	1	1	1	1	1		1	
Pterostichus novus Straneo							1	1	1						
Pterostichus pensylvanicus LeConte			1	1	1	1	1	1	1	1	1	1		1	
Stenolophus ochropezus (Say)							1	1	1	1	1				
Syntomus americanus (Dejean)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Synuchus impunctatus (Say)				1	1	1	1	1	1	1	1	1		1	
Total species by jurisdiction	**20**	**15**	**32**	**55**	**54**	**61**	**68**	**61**	**60**	**48**	**46**	**37**	**14**	**35**	

Discussion

Vascular Plants and Plant Communities

The Gardenton Community Pasture is made up of a complex mix of habitat types, based largely upon subtle changes in topography and soils. These habitats are affected differently by grazing activities within the pasture, due to the preferences of the animals found there and the intensity of the grazing pressure they exert on the plants.

The majority of the pasture consists of sedge meadow and marsh plant communities, dominated by an array of sedges, rushes and willows. These habitats appeared to be in better condition than the grasslands and woodlands in the pasture, because the cattle grazed uplands preferentially. The dominant sedges of these areas are largely avoided by cattle after the first few weeks of spring because of their high fibre and low protein content (Janet Moore, pers. comm. 1998). Cattle were seen in the wetlands, but did not seem to graze there heavily, choosing instead to travel through the wetlands to get to nearby uplands. The result is that the cattle and horses were concentrated on the uplands and tended to graze them heavily relative to the lightly grazed sedge meadows and marshes.

The most heavily grazed grasslands were generally not sampled in this inventory due to the difficulty of identifying plants. In these areas, livestock often grazed grass and forb species to within a few centimetres of the soil surface. Big bluestem and other typical tall grass prairie species were less abundant there than in the lighter-grazed areas. Cattle appeared to graze native grasses selectively, reducing their cover and making them more difficult to detect. Intensive season-long grazing also appeared to favour grazing-increaser species such as redtop (*Agrostis stolonifera*) and tufted hairgrass (*Deschampsia caespitosa*).

Heavy grazing can reduce the amount of above ground competition among plants and expose the soil surface, allowing new species to colonize. Exotic species may be expected to appear under these circumstances. Smooth brome (*Bromus inermis*) and white and yellow sweet clover (*Melilotus alba, M. officinalis*) were encountered on the outskirts of the pasture where seed was able to disperse from roadsides, however they were uncommon further from the edges of the pasture. Weedy species such as western dock (*Rumex occidentalis*) and thistles (*Cirsium arvense, C. vulgare*) were found in heavily grazed areas and along roadsides. However, there was no St. John's wort (*Hypercium perforatum*) or leafy spurge (*Euphorbia esula*) found in the pasture. These two noxious weeds were increasing in abundance and becoming a concern nearby in the Tall Grass Prairie Preserve.

Areas in which grazing has been restricted, such as the cemetery and the lane separating field A4 from fields A1C, A1 and A1A, or where grazing is light, such as the field west of the pasture headquarters, had a species composition more typical of better quality tall grass prairie communities. This suggests that the more heavily grazed areas of tall grass prairie within the pasture may be able to recover somewhat with rest from heavy grazing. The use of rotational grazing practices may slow further degradation of these grasslands. A rotational grazing demonstration site nearby in the Manitoba Tall Grass Prairie Preserve has produced encouraging preliminary results in native tall grass prairie communities. The study has found that rotational grazing prevents excess litter build up and allows native tall grass prairie species to compete more successfully with non-native species, but not at the expense of grazing-increaser species.

Aspen, oak and balsam poplar dominate woodlands within the pasture. Most stands consist mainly of immature to medium-sized aspen with a few large bur oaks and balsam poplars scattered throughout. This size structure can likely be explained by the fire history within the pasture. Before the area was designated as a community pasture, large burns occurred throughout the area on a near-annual basis (Harvey Hill, pers. comm. 1997). Since the pasture was created, few fires have occurred within the pasture. Thus, the aspen stands are relatively young and even-aged because of their suckering response to fire, while oak and balsam poplar apparently survived the burns and are older.

The understorey of small woodlands tended to be more heavily grazed than larger ones, for several possible reasons. First, there are often more species typical of grasslands found in small aspen bluffs than in large

ones. Since these woodlands are often encroaching upon grasslands, the open edges of these bluffs often continue to have many typical grassland species in their understorey. Species such as big bluestem and redtop, for example, are generally not found in aspen woodlands, but were encountered in some of the small woodlands sampled. In larger, denser woodlands, species composition shifts, with shrubs out-competing herbs, which may make for less desirable grazing. Secondly, there is greater accessibility for cattle to smaller woodlands than to larger ones. As tree and shrub density increase away from the woodland edges, cattle may not be able to move easily through these areas. Thus, small woodlands with higher proportions of edge relative to interior would tend to be more intensively grazed.

Two species found within the pasture are protected under provincial legislation. Great Plains ladies'-tresses (*Spiranthes magnicamporum*), listed as Endangered under the Manitoba *Endangered Species Act*, was found in three sedge meadows within fields A1C, A2A and A3A. Three small populations of Riddell's goldenrod (*Solidago riddellii*) were documented in sedge meadows within fields A2B and A2C (two populations). Riddell's goldenrod is listed as Threatened in the Manitoba *Endangered Species Act* and is listed as a species of Special Concern by COSEWIC (Committee on the Status of Endangered Wildlife in Canada). In addition whorled loosestrife (*Steironema quadriflorum*), listed as a rare species (S2) by the Manitoba Conservation Data Centre, was found five times in the sedge meadows and woodlands of fields A2C (two populations), A5 (two populations) and A4, respectively. These plants may be rare because of heavy loss of prairie habitat, as well as the fact that several species reach the northern limit of their range in the area. The presence of these three species in lightly grazed areas suggests that they tolerate a moderate level of disturbance, which may reduce competition by other species, but are susceptible to heavy disturbance, and thus were not found in the intensively grazed grasslands examined.

The level of grazing disturbance affected the four major habitat types in the pasture differentially, which in turn affected the quality of habitat they provide for plants and animals. However, a significant number of plant and animal species were supported by the pasture's habitats. Although grazing has clearly had an effect on some of the pasture's flora and fauna, the Gardenton Pasture represented an important link to the Manitoba Tall Grass Prairie Preserve and the Caribou Wildlife Management Area.

Terrestrial Vertebrates and Butterflies

The objectives of the vertebrate component of the Gardenton PFRA Community Pasture bioinventory were to inventory the vertebrate fauna of the pasture and to report on the presence of rare animal species in the pasture.

Initially, it was expected that three large homogenous areas of the pasture's major habitat types - grassland, aspen woodland and edge (grassland - woodland transition area) would be sampled. Due to the large area required to carry out the point count sampling, however, it became necessary to find three smaller areas representative of all three habitats. By doing so, each of the habitat types was distributed in each of the three representative areas.

Differences in the three sampling areas were related to the amount of upland versus wetland habitat each of them contained. This, in turn, led to differences grazing activity levels, since cattle tended to avoid the wetlands and concentrate in the uplands. Sampling area 1, situated at the southern end of the pasture, ranged from dry to wet. It was grazed throughout most of the study period. Sampling area 2, near the centre of the pasture, was noticeably wetter during the course of this study. Grazing activity was minimal there until mid-August when it began to dry out and grazing became more evident. Sampling area 3, in the northernmost part of the pasture, ranged from dry to wet during the sampling period. Grazing activity in this area was light, limited to the pasture horses. These differences resulted in some differences in species composition between the three sampling areas. For each of the three habitat types, roughly 50% of the bird species were recorded in only one of the three sampling areas. Arguably, this created a more comprehensive species list for the pasture than if all sampling areas were more homogeneous.

Only three bird species were present in all three habitat types - American Robin, American Crow and Mourning Dove (Table 13). Twenty-six (26) species were detected in two of the three habitat types and

43 species were found exclusively in one habitat type. The edge habitat, with the highest number of species, appeared to provide suitable habitat for the most species because of its mix of grassland and woodland components. All 26 of the species found in two of three habitats were found in the edge habitat, plus either grassland or woodland; none of these 26 species was found only in grassland and woodland. The edge habitat also had the most species found exclusively in one habitat type, again, presumably because the greater diversity of microhabitat can support a more diverse avian community. However, although the edge habitat supported the highest number of species, it contained fewer total birds than the other two habitats. The highest bird numbers were recorded in the aspen woodland habitat (243 total), compared with 225 in the grassland habitat and 204 for edge habitat.

A species list was compiled for each study area, as well as for the pasture as a whole. Included in the overall list are species observed outside of the point count and trapping sites. General observations of species allowed for large mammals, reptiles, amphibians and butterflies to be included in the inventory. Existing species lists from the area (Borkowsky 1996, Derenchuk and Ward 1996, Moore and Fortney 1994) were used as reference. Based on these lists, two species found in the Gardenton Community Pasture (Meadow Jumping Mouse and Western Painted Turtle) were added as sightings new to the area.

The Rufous-sided Towhee, was detected on two occasions and noted. Breeding populations of this species are ranked S2S3 (rare provincially) by the Manitoba Conservation Data Centre (Duncan, 1996). No other species found in this report was ranked by the Manitoba Conservation Data Centre as S1 (very rare) to S3 (uncommon), or with a provincial range covering less than 10% of Manitoba's area.

The late start of the study may have affected detection of some species, since breeding of birds had begun prior to this study's commencement. Several rare butterflies known from this region may also have been missed due to the late start. Future studies of this kind could be improved by beginning earlier in the spring to facilitate the detection of additional species.

Carabid Beetles

This study offered the opportunity to conduct a preliminary investigation into the ecological affinities of the Carabidae, in addition to providing a list of ground beetle species on the Gardenton PFRA Community Pasture.

This report documents the presence of species of Carabidae in the Gardenton Community Pasture, with comments on their ecological affinities. It is a reference for the existence of carabid species in Manitoba. The absence of a particular species from this study should not necessarily be interpreted as conclusive evidence that the species is missing from the Gardenton Community Pasture. Sampling began late in the season, meaning that spring species may be underrepresented or absent from the inventory. The project was limited to a small part of the pasture, and the sample period only covered three months. Some trap attrition occurred during the sampling period; cattle stepped on the pitfall trap lids and completely excavated some collection containers. Several flight intercept panels and troughs were destroyed as well.

In pitfall traps 1-5, placed in a relatively dry area, *Agonum cupripenne* (Say), *Agonum cupreum* Dejean, and *P. lucublandus* (Say) comprised 44, 18, and 11 per cent of carabids collected, respectively. These species prefer open, relatively dry prairie habitat (Appendix H). The catch in PF 1-5 accounted for over 47 per cent of the total number of *A. cupripenne* collected in all 60 traps. In contrast, PF 55-60, which were placed along a water-filled ditch, were dominated by *Agonum errans* (Say) and *Chlaenius s. sericeus* (Forster) (34 and 23 per cent of total catch, respectively). Both species are quite hygrophilous, and usually found around water. Overall, within the Community Pasture there is a combination of hygrophilous and more xerophilous species represented. Moisture levels of the areas immediately surrounding each trap series are given in Table 4. These are only relative terms, as even the traps in the drier areas were certainly not dry.

A biodiversity study was underway at the St. Charles Rifle Range, Winnipeg at the time of the Gardenton Community Pasture survey. This study examined the effects of seasonal burning on the invertebrate fauna

of the tall grass prairie. Specimens were collected using the same techniques as in the Community Pasture project. The study areas have undergone different treatments (grazing and burning regimes), but comparisons can be drawn between the two. Differences between the St. Charles Rifle Range and the Gardenton Community Pasture can probably be attributed to the different moisture levels. The Rifle Range is considerably drier, and therefore xerophilous species such *Agonum placidum* (Say), *Calosoma calidum* (Fabricius), *Chlaenius purpuricollis* Randall, and *Harpalus somnulentus* Dejean are more abundant there. More hygrophilous species such as *Carabus m. meander* Fischer, *Agonum errans*, and *Pterostichus novus* were present in the Community Pasture, but absent at the St. Charles Rifle Range (Tables 17 and 20).

References

Borkowsky, C. 1995. Manitoba Tall Grass Prairie Preserve Natural Resources Inventory II, 1995. Technical Report No. 98-04W. Manitoba Department of Natural Resources, Wildlife Branch. Winnipeg, MB. 30 pp.

Borkowsky, C. 1996. Manitoba Tall Grass Prairie Preserve Natural Resources Inventory III, 1996. Technical Report No. 99-01W. Manitoba Department of Natural Resources, Wildlife Branch. Winnipeg, MB. 37 pp.

Borkowsky, C. 1997. Manitoba Tall Grass Prairie Preserve Natural Resources Inventory IV, 1997. Technical Report No. 99-04W. Manitoba Department of Natural Resources, Wildlife Branch. Winnipeg MB. 46 pp.

Bousquet, Y. (Editor). 1991. Checklist of Beetles of Canada and Alaska. Agriculture Canada. Ottawa, ON.

Dale, B. and G.L. Holroyd (compilers). 1994. Bird surveys: A workshop on integrated monitoring techniques. Reference Manual. Unpubl. manuscript. Canadian Wildlife Service. Edmonton, AB. Unpagenated.

Dana, R. 1997. Personal communication. Minnesota County Biological Survey, St. Paul MN.

Davis, S. K. 1994. Manitoba Tall Grass Prairie Preserve Natural Resources Inventory I, 1994. Technical Report No. 98-03W. Manitoba Department of Natural Resources, Wildlife Branch. Winnipeg, MB. 41 pp.

Derenchuk, D. and I. Ward. 1996. Personal communication to the Manitoba Natural Resources, Wildlife Branch. Winnipeg, MB.

Duncan, J.R. 1996. Conservation status ranks of the birds of Manitoba. Manitoba Conservation Data Centre MS Report No. 96-05. Winnipeg, MB. 26 pp.

Ehrlich, W.A., E.A. Poyser, L.E. Pratt and J.H. Ellis. 1953. Report of reconnaissance soil survey of Winnipeg and Morris map sheet areas. Soil Report. No. 5, Man. Dept. Agric, Winnipeg MB. 111 pp.

Greig-Smith, P. 1983. Quantitative plant ecology. 3rd ed. University of California Press. Berkley and Los Angeles CA.

Hill, H. 1997. Personal communication. Former Gardenton Pasture Manager.

Johnson, K. 1997. Personal communication. Acting Gardenton Pasture Manager.

Joyce, J. and J.P. Morgan. 1989. Manitoba's tall-grass prairie conservation project. In: Proceedings of the Twelfth North American Prairie Conference, T.B. Bragg and J. Stuppendick, Eds. University of Nebraska Press, Lincoln NE.

Kershaw, K.A. 1975. Quantitative and dynamic plant ecology. 2nd ed. Edward Arnold Ltd. London.

Lindroth, C.H. 1961-1969. The ground-beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska. Opuscula Entomologica Supplementum 20 (1961): 1-200; 24 (1963): 201-408; 29 (1966): 409-648; 33 (1968): 649-944; 34 (1969a): 945-1192; 35 (1969b): iii-xlviii.

Manitoba Avian Research Committee. 1995. Field checklist of the birds of southeastern Manitoba. Manitoba Naturalists Society, Winnipeg MB. 12 pp.

Manitoba Remote Sensing Centre. 1994. Land use/land cover map, southeast Manitoba. Landsat™ classified imagery, 1:100,000 scale. Manitoba Natural Resources, Land Information Centre, Winnipeg MB.

Moore, J. 1998. Personal communication. Critical Wildlife Habitat Program, Winnipeg MB.

Moore, J.R. and G. Fortney. 1994. Eds. Management plan for the Tall Grass Prairie Preserve in Manitoba. Critical Wildlife Habitat Program, Winnipeg MB. 34 pp. plus appendices.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. Gen. Tech. Rep. PSW-GRT-144. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. Albany, CA: 41 p.

Scoggan, H.J. 1978. Flora of Canada. National Museum of Canada. National Museum of Natural Sciences. Nat. Mus. Can., Ottawa ON.

Slogan, J. 1997. Personal communication.

Appendix A.Formulae for vegetation analysis calculations.

Calculations are specific to plant community type (i.e. grassland), not the entire Community Pasture.

Trees:

$$\text{Mean Canopy Cover (\%)} = \frac{\text{total estimated cover area (\%) for species in all plots}}{\text{\# of plots}}$$

$$\text{Density (trees/ha)} = \frac{\text{total \# of trees of species counted}}{\text{\# of plots (100 m}^2\text{ each)}} \times 100 \text{ plots/ha}$$

Shrubs:

$$\text{Mean density (stems/quadrat)} = \frac{\text{total \# of stems of species}}{\text{\# of quadrats (25 m}^2\text{ each)}}$$

Mean density (stems/ha) = stems/quadrat x 400 quadrats/ha

Herbs:

$$\text{Mean Cover (\%)} = \frac{\text{total estimated cover area (\%) for species in all quadrats}}{\text{\# of quadrats}}$$

$$\text{Frequency (1 m x 1 m quadrats)} = \frac{\text{\# of 1 m x 1 m quadrats in which a species occurred}}{\text{\# of quadrats}}$$

$$\text{Frequency (10 m x 10 m plots)} = \frac{\text{\# of 10 m x 10 m plots in which a species occurred}}{\text{\# of plots}}$$

Appendix B. Vascular plant species list.

Observations made in Gardenton PFRA Community Pasture, June - September 1997.
Habitat types in which species were sampled or observed are abbreviated as follows:

- A - Aspen-Oak woodland
- G - Grassland
- S - Sedge meadow
- M - Marsh
- I - Incidental observation with no information on habitat

Nomenclature follows Scoggan (1978).

Scientific Name	Common Name	Family	Habitat
Acer negundo L.	Manitoba maple	Aceraceae	I
Achillea millefolium L.	Common yarrow	Asteraceae	A G S
Acorus calamus L.	Sweetflag	Araceae	S
Agastache foeniculum (Pursh) Ktze.	Blue giant hyssop	Lamiaceae	I
Agoseris glauca (Nutt.) Greene	False dandelion	Asteraceae	A G
Agrimonia striata Michx.	Agrimony	Rosaceae	A
Agropyron dasystachyum (Hook) Scribn.	Northern wheat grass	Poaceae	I
Agropyron repens (L.) Beauv.	Couch-grass, Quack-grass	Poaceae	I
Agropyron smithii Rydb.	Western wheat grass	Poaceae	G
Agropyron trachycaulum (Link) Malte	Slender wheat grass	Poaceae	A G S
Agrostis stolonifera L.	Redtop	Poaceae	A G S
Alisma plantago-aquatica L.	Common water-plantain	Alismataceae	G S M
Alnus rugosa (Du Roi) Spreng.	Speckled alder	Betulaceae	S
Amelanchier alnifolia Nutt.	Saskatoon	Rosaceae	A G
Andropogon gerardii Vitman	Big bluestem	Poaceae	A G S
Anemone canadensis L.	Canada anemone	Ranunculaceae	A G S
Anemone cylindrica Gray	Thimbleweed	Ranunculaceae	A G
Anemone quinquefolia L.	Wood anemone	Ranunculaceae	G
Antennaria spp.	Pussy-toes	Asteraceae	A G
Apocynum cannabinum L.	Indian-hemp	Apocynaceae	G S
Artemisia ludoviciana Nutt.	Western mugwort	Asteraceae	A
Asclepias incarnata L.	Swamp milkweed	Asclepiadaceae	G S M
Asclepias ovalifolia Dcne.	Dwarf milkweed	Asclepiadaceae	A G S
Asclepias syriaca L.	Common or Silky milkweed	Asclepiadaceae	A
Aster ciliolatus Lindl.	Lindley's aster	Asteraceae	A G
Aster ericoides L.	Heath or Many-flowered aster	Asteraceae	A G S
Aster laevis L.	Smooth aster	Asteraceae	A G
Aster novae-angliae L.	New England aster	Asteraceae	S
Aster ptarmicoides (Nees) T. & G.	White upland aster	Asteraceae	G S
Aster puniceus L.	Purple-stemmed aster	Asteraceae	A G S M
Aster simplex Willd.	Small blue aster	Asteraceae	A

Scientific Name	Common Name	Family	Habitat
Astragulus adsurgens Pallas	Ascending milkvetch	Fabaceae	I
Astragulus agrestis Dougl.	Milkvetch	Fabaceae	I
Betula pumila L.	Dwarf birch	Betulaceae	A S M
Bidens frondosa L.	Common beggarticks	Asteraceae	A G
Bromus ciliatus L.	Fringed brome	Poaceae	G
Bromus inermis Leys.	Smooth brome	Poaceae	G S
Calamagrostis canadensis (Michx.) Nutt.	Marsh reed grass	Poaceae	A S M
Calamagrostis inexpansa Gray	Northern reed grass	Poaceae	A G S M
Calamagrostis neglecta (Ehrh.) Gaertn., Mey. & Scherb.	Narrow reed grass	Poaceae	I
Campanula aparinoides Pursh	Marsh bellflower	Campanulaceae	S M
Campanula rotundifolia L.	Harebell	Campanulaceae	A G
Carex aquatilis Wahl.	Water sedge	Cyperaceae	M
Carex aurea Nutt.	Golden sedge	Cyperaceae	A G S
Carex brevior (Dew.) Mack.	Fescue sedge	Cyperaceae	A G
Carex buxbaumii Wahl.	Brown sedge	Cyperaceae	G S M
Carex crawei Dew.	Erect sedge	Cyperaceae	A G
Carex lanuginosa Michx.	Woolly sedge	Cyperaceae	A G S M
Carex lasiocarpa Ehrh.	Hairy-fruited sedge	Cyperaceae	S M
Carex praegracilis Boott	Graceful sedge	Cyperaceae	A G S
Carex rostrata Stokes	Beaked sedge	Cyperaceae	A S M
Carex sartwellii Dew.	Sartwell's sedge	Cyperaceae	G S M
Carex viridula Michx.	Green sedge	Cyperaceae	I
Carex spp.	Sedge species	Cyperaceae	A G
Cerastium arvense L.	Field chickweed	Caryophyllaceae	I
Chenopodium album L.	Lamb's-quarters	Chenopodiaceae	I
Cicuta maculata L.	Water-hemlock	Apiaceae	G S
Cirsium arvense (L.) Scop.	Canada thistle	Asteraceae	A G
Cirsium vulgare (Savi) Tenore	Bull thistle	Asteraceae	I
Comandra umbellata (L.) Nutt.	Bastard-toadflax	Santalaceae	A G
Cornus stolonifera Michx.	Red-osier dogwood	Cornaceae	A G S
Corylus cornuta Marsh.	Beaked hazelnut	Betulaceae	A G
Crataegus rotundifolia Moench	Round-leaved hawthorn	Rosaceae	A G
Crepis tectorum L.	Narrow-leaved hawks-beard	Asteraceae	A G
Danthonia spicata (L.) Beauv.	Poverty oat grass	Poaceae	A
Deschampsia caespitosa (L.) Beauv.	Tufted hairgrass	Poaceae	G S M
Dracocephalum virginianum L.	False dragonhead	Lamiaceae	S
Echinacea pallida Nutt.	Purple coneflower	Asteraceae	I
Elaeagnus commutata Bernh.	Silverberry, Wolf-willow	Eleagnaceae	A

Scientific Name	Common Name	Family	Habitat
Eleocharis spp.	Spike-rush	Cyperaceae	G S M
Equisetum arvense L.	Common horsetail	Equisetaceae	A G
Equisetum hyemale L.	Common scouring-rush	Equisetaceae	A G M
Equisetum pratense Ehrh.	Meadow horsetail	Equisetaceae	A
Erigeron glabellus Nutt.	Smooth fleabane	Asteraceae	A G
Erigeron philadelphicus L.	Philadelphia fleabane	Asteraceae	A
Erigeron strigosus Muhl.	Daisy fleabane	Asteraceae	G
Eriophorum spp.	Cotton-grass	Cyperaceae	S M
Fragaria virginiana Dcne.	Smooth wild strawberry	Rosaceae	A G S
Fraxinus pennsylvanica Marsh.	Green ash	Oleaceae	G
Galium boreale L.	Northern bedstraw	Rubiaceae	A G S
Gentiana andrewsii Griseb.	Closed gentian	Gentianaceae	G S
Gentianella crinita (Froel.) Don	Fringed gentian	Gentianaceae	I
Gerardia purpurea L.	Large purple agalinis	Scrophulariaceae	G S
Gerardia tenuifolia Vahl	Slender agalinis	Scrophulariaceae	I
Geum macrophyllum Willd.	Large-leaved avens	Rosaceae	I
Glycyrrhiza lepidota (Nutt.) Pursh	Wild licorice	Fabaceae	A G
Hedysarum alpinum L.	American hedysarum	Fabaceae	I
Helianthus laetiflorus Pers.	Beautiful sunflower	Asteraceae	A G S
Heuchera richardsonii R. Br.	Alumroot	Saxifragaceae	I
Hieracium scabriusculum Schwein	Hawkweed	Asteraceae	A
Hierochloe odorata (L.) Beauv.	Sweet grass	Poaceae	A G
Hippuris vulgaris L.	Mare's-tail	Hippuridaceae	I
Hordeum jubatum L.	Wild barley	Poaceae	G
Hypoxis hirsuta (L.) Coville	Yellow stargrass	Amaryllidaceae	G
Juncus alpinus Vill.	Alpine rush	Juncaceae	G S M
Juncus balticus Willd.	Baltic rush	Juncaceae	A G S M
Juncus compressus Jacq.	Flattened rush	Juncaceae	G S
Juncus dudleyi Wieg.	Dudley's rush	Juncaceae	G S
Juncus nodosus L.	Knotted rush	Juncaceae	A G S M
Juncus torreyi Coville	Torrey's rush	Juncaceae	G S
Koeleria cristata (L.) Pers.	June grass	Poaceae	G
Lathyrus venosus Muhl.	Wild peavine	Fabaceae	A
Lathyurus palustris L.	Marsh vetchling	Fabaceae	A G S
Lemna minor L.	Lesser duckweed	Lemnaceae	S M
Liatris ligulistylis (*Nels.*) Schum.	Meadow blazingstar	Asteraceae	G
Lilium philadelphicum L. Wood	Lily	Liliaceae	A G
Lobelia kalmii L.	Kalm's lobelia	Lobeliaceae	A G S M
Lonicera dioica L.	Limber or Twining honeysuckle	Caprifoliaceae	A M

Scientific Name	Common Name	Family	Habitat
Lycopus americanus Muhl.	Water-horehound	Lamiaceae	A G S M
Lysimachia thyrsiflora L.	Tufted loosestrife	Primulaceae	S M
Maianthemum canadense Desf.	Two-leaved Solomon's-seal	Liliaceae	A G
Medicago lupulina L.	Black medick	Fabaceae	G
Medicago sativa L.	Alfalfa, Lucerne	Fabaceae	I
Melilotus alba Desr.	White sweet clover	Fabaceae	A G
Melilotus officinalis (L.) Pallas	Yellow sweet clover	Fabaceae	G
Mentha arvensis L.	Common mint	Lamiaceae	G S M
Monarda fistulosa L.	Wild bergamot	Lamiaceae	A G
Muhlenbergia asperifolia (L.) Pers.	Scratch grass	Poaceae	G
Muhlenbergia richardsonis (Trin.) Rydb.	Mat muhly	Poaceae	A G
Panicum virgatum L.	Switchgrass	Poaceae	A G S
Parnassia palustris L.	Northern grass-of-Parnassus	Saxifragaceae	G
Pedicularis canadensis L.	Wood-betony	Scrophulariaceae	A
Pedicularis lanceolata Michx.	Swamp lousewort	Scrophulariaceae	A G S
Petalostemum candidum (Willd.) Michx.	White prairie-clover	Fabaceae	I
Petalostemum purpureum (Vent.) Rydb.	Purple prairie-clover	Fabaceae	G
Petasites sagittatus (Pursh) Gray	Arrow-leaved colt's-foot	Asteraceae	A
Phalaris arundinacea L.	Reed canary grass	Poaceae	I
Phleum pratense L.	Timothy	Poaceae	A G
Phragmites australis (Cav.) Trin.	Common reed grass	Poaceae	M
Plantago major L.	Common plantain, Whiteman's-foot	Plantaginaceae	G
Platanthera hyperborea Lindley	Bog orchis	Orchidaceae	I
Poa spp.	Blue grass species	Poaceae	A G S
Polygala senega L.	Seneca snakeroot	Polygalaceae	A
Polygonum amphibium L.	Water smartweed	Polygonaceae	G S M
Populus balsamifera L.	Balsam poplar	Salicaceae	A G
Populus deltoides Bartr.	Cottonwood	Salicaceae	I
Populus tremuloides Michx.	Trembling aspen	Salicaceae	A G S
Potamogeton gramineus L.	Various-leaved pondweed	Zosteraceae	M
Potentilla anserina L.	Silverweed	Rosaceae	G S M
Potentilla fruticosa L.	Shrubby cinquefoil	Rosaceae	G S M
Prunella vulgaris L.	Heal-all	Lamiaceae	A G
Prunus virginiana L.	Choke cherry	Rosaceae	A G
Pyrola asarifolia Michx.	Pink pyrola, Wintergreen	Pyrolaceae	A
Pyrola elliptica Nutt.	Shinleaf	Pyrolaceae	A
Pyrola rotundifolia L.	Round-leaved pyrola	Pyrolaceae	I
Quercus macrocarpa Michx.	Bur oak, Mossy-cup oak	Fagaceae	A G

Scientific Name	Common Name	Family	Habitat
Ranunculus cymbalaria Pursh	Seaside crowfoot	Ranunculaceae	G
Rhus radicans L.	Poison-ivy	Anacardiaceae	A G
Ribes oxyacanthoides L.	Bristly wild gooseberry	Saxifragaceae	A G S
Rosa acicularis Lindl.	Prickly rose	Rosaceae	A G S
Rubus idaeus L.	Wild red raspberry	Rosaceae	A
Rubus pubescens Raf.	Dewberry	Rosaceae	A
Rudbeckia hirta L.	Black-eyed Susan	Asteraceae	A G
Rumex occidentalis Wats.	Western dock	Polygonaceae	I
Sagittaria latifolia Willd.	Broad-leaved arrowhead	Alismataceae	I
Salix bebbiana Sarg.	Bebb's willow, Beaked willow	Salicaceae	A G S M
Salix candida Flugge.	Hoary willow	Salicaceae	I
Salix discolor Muhl.	Pussy willow	Salicaceae	A S
Salix exigua Nutt.	Sandbar willow	Salicaceae	A
Salix lucida Muhl.	Shining willow	Salicaceae	S
Salix lutea Nutt.	Yellow willow	Salicaceae	A G S
Salix petiolaris Sm.	Basket willow	Salicaceae	A G S M
Salix spp.	Willow species	Salicaceae	A
Sanicula marilandica L.	Snakeroot	Apiaceae	A
Scirpus lacustris L.	Lake bulrush	Cyperaceae	M
Senecio aureus L.	Golden ragwort	Asteraceae	A G S
Sisyrinchium montanum Greene	Common blue-eyed grass	Iridaceae	G
Sium suave Walt.	Water-parsnip	Apiaceae	S M
Smilacina stellata (L.) Desf.	Star-flowered Solomon's-seal	Liliaceae	A
Smilax herbacea L.	Carrion flower	Liliaceae	A G
Solidago canadensis L.	Canada goldenrod	Asteraceae	A G S
Solidago graminifolia (L.) Salisb.	Flat-topped goldenrod	Asteraceae	G S
Solidago mollis Bartl.	Velvety goldenrod	Asteraceae	I
Solidago nemoralis Ait.	Showy goldenrod	Asteraceae	A G S
Solidago riddellii Frank	Riddell's goldenrod	Asteraceae	S
Solidago rigida L.	Stiff goldenrod	Asteraceae	A G
Sonchus arvensis L.	Field sow-thistle	Asteraceae	A G
Spartina pectinata Link	Slough grass	Poaceae	A G S M
Spiraea alba Du Roi	Meadowsweet	Rosaceae	A G S M
Spiranthes magnicamporum Sheviak	Great Plains ladies'-tresses	Orchidaceae	I
Spiranthes romanzoffiana Cham.	Hooded ladies'-tresses	Orchidaceae	S
Stachys palustris L.	Woundwort	Lamiaceae	G S M
Steironema ciliatum (L.) Raf.	Fringed loosestrife	Primulaceae	A G M
Steironema quadriflorum (Sims) Hitchc.	Whorled loosestrife	Primulaceae	A S M
Symphoricarpos occidentalis Hook.	Western snowberry	Caprifoliaceae	A

Scientific Name	Common Name	Family	Habitat
Taraxacum officinale Weber	Common dandelion	Asteraceae	A G
Thalictrum dasycarpum Fisch. & Lall.	Tall or Purple meadow-rue	Ranunculaceae	A G S
Thalictrum venulosum Trel.	Veiny meadow-rue	Ranunculaceae	A
Trifolium pratense L.	Red clover	Fabaceae	A G
Trifolium repens L.	White clover	Fabaceae	A G
Triglochin maritima L.	Seaside arrow-grass	Juncaginaceae	S M
Typha latifolia L.	Common cattail	Typhaceae	M
Ulmus americana L.	American elm, White elm	Ulmaceae	A
Urtica dioica L.	Stinging nettle	Urticaceae	I
Utricularia vulgaris L.	Greater bladderwort	Lentibulariaceae	S M
Viburnum lentago L.	Nannyberry	Caprifoliaceae	I
Vicia americana Muhl.	Common vetch	Fabaceae	A G
Viola adunca Sm.	Early blue violet	Violaceae	I
Viola nephrophylla Greene	Northern bog violet	Violaceae	A G S
Viola spp.	Violet	Violaceae	A G M
Zigadenus elegans Pursh	White camas	Liliaceae	G
Zizia aptera (Gray) Fern.	Heart-leaved Alexanders	Apiaceae	A G
Zizia aurea (L.) Koch	Golden Alexanders	Apiaceae	A G S

Appendix C. Locations of point counts for bird sampling.

Gardenton PFRA Community Pasture, July-August 1997.
Sites marked with an asterisk (*) were also used for small mammal trapping.

Point Count Site	Habitat Type	Latitude	Longitude
Sampling Area 1			
1 *	Edge	49°00'57"N	96°40'04"W
2	Grassland	49°01'00"N	96°39'51"W
3	Edge	49°01'09"N	96°39'55"W
4	Aspen	49°01'09"N	96°39'52"W
5 *	Grassland	49°00'51"N	96°40'03"W
6	Grassland	49°00'48"N	96°40'23"W
7 *	Aspen	49°00'39"N	96°40'08"W
8	Aspen	49°00'44"N	96°40'27"W
9	Aspen	49°00'55"N	96°40'20"W
10	Grassland	49°00'55"N	96°40'34"W
11	Edge	49°01'01"N	96°40'41"W
12	Edge	49°00'58"N	96°41'30"W
Sampling Area 2			
1	Edge	49°01'48"N	96°36'17"W
2	Grassland	49°01'39"N	96°36'01"W
3	Grassland	49°01'46"N	96°35'43"W
4 *	Edge	49°01'41"N	96°35'24"W
5 *	Grassland	49°01'24"N	96°35'24"W
6	Edge	49°01'32"N	96°35'23"W
7 *	Aspen	49°01'36"N	96°36'19"W
8	Aspen	49°01'33"N	96°36'09"W
9	Aspen	49°01'31"N	96°36'07"W
10	Aspen	49°01'29"N	96°36'04"W
11	Edge	49°01'42"N	96°37'10"W
12	Grassland	49°01'41"N	96°36'55"W
Sampling Area 3			
1	Edge	49°04'22"N	96°39'32"W
2	Aspen	49°04'23"N	96°39'45"W
3	Edge	49°04'16"N	96°39'41"W
4	Edge	49°04'09"N	96°39'35"W
5 *	Grassland	49°04'01"N	96°39'23"W
6 *	Edge	49°04'12"N	96°39'23"W
7	Grassland	49°04'05"N	96°39'15"W
8	Grassland	49°04'09"N	96°39'14"W
9	Grassland	49°04'21"N	96°39'16"W
10 *	Aspen	49°04'22"N	96°39'24"W
11	Aspen	49°04'26"N	96°39'21"W
12	Aspen	49°04'23"N	96°39'20"W

Appendix D. Gardenton PFRA Community Pasture mammal checklist with relative abundance estimates.

Family	Common name	Scientific name	Abundance
Procyonidae			
	Raccoon (tracks)	Procyon lotor	O*
Mustelidae			
	Striped Skunk	Mephitis mephitis	O†
Canidae			
	Red Fox	Vulpes vulpes	O†
Scuridae			
	Thirteen-lined Ground Squirrel	Citellus tridecemilineatus	O
	Franklin's Ground Squirrel	Citellus franklini	C*
	Eastern Chipmunk	Tamias striatus	UC*
Castoridae			
	American Beaver	Castor canadensis	O
Cricetidae			
	Meadow Vole	Microtus pennsylvanicus	C
	Red-backed Vole	Clethrionomys gapperi	C
Zapodidae			
	Meadow Jumping Mouse	Zapus hudsonius	C
Cervidae			
	White-tailed Deer	Odocoileus virginianus	C* -in July

* Based on incidental observation, outside the sampling area.
† Observed adjacent to, but outside of the pasture.
A = ABUNDANT - observed on most visits in preferred habitats during the study period.
C = COMMON - observed on many visits in preferred habitat during the study period.
UC = UNCOMMON - infrequently observed in preferred habitat during the study period.
R = RARE - seldom observed during the study period, but expected to occur.
O = OCCASIONAL - observed one time only during the study period.

Appendix E. Gardenton PFRA Community Pasture reptile and amphibian checklist with relative abundance estimates.

Family	Common name	Scientific name	Abundance *
	Reptiles		
Chelydridae			
	Western Painted Turtle	Chrysemys picta belli	O
Colubridae			
	Western Plains Garter Snake	Thamnophis radix haydeni	A
	Amphibians		
Bufonidae			
	American Toad	Bufo americanus	UC
Hylidae			
	Boreal Chorus Frog	Pseudacris triseriata maculata	C
	Gray Treefrog	Hyla versicolor	C
Ranidae			
	Leopard Frog	Rana pipiens	A
	Wood Frog	Rana sylvatica	C

*Based on incidental observations, outside of the sampling area.
A = ABUNDANT - observed on most visits in preferred habitats during the study period.
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R = RARE - seldom observed during the study period, but expected to occur.
O = OCCASIONAL - observed one time only during the study period.

Appendix F. Gardenton PFRA Community Pasture butterfly checklist with relative abundance estimates.

Family	Common name	Scientific name	Abundance *
Pieridae			
	Cabbage White	Pieris rapae	C
	Alfalfa Butterfly	Colias eurytheme	C
Nymphalidae			
	Mourning Cloak	Nymphalis antiopa	C
	Viceroy	Limenitis archippus	C
Satyridae			
	Common Wood Nymph	Ceryonis pegala	C
Danaidae			
	Monarch	Danaus plexippus	C

* Based on incidental observations, outside of the sampling area.
A = ABUNDANT - observed on most visits in preferred habitats during the study period.
C = COMMON - observed on many visits in preferred habitat during the study period.
UC = UNCOMMON - infrequently observed in preferred habitat during the study period.
R = RARE - seldom observed during the study period, but expected to occur.
O = OCCASIONAL - observed one time only during the study period.

Appendix G. Gardenton PFRA Community Pasture bird checklist with relative abundance estimates.

Based on information gathered July and August 1997.

Family Common name	Scientific name	Abundance
Ardeidae		
Great Blue Heron	*Ardea herodias*	UC*
Anatidae		
Blue-winged Teal	*Anas discors*	A*
Canada Goose	*Branta canadensis*	C**
Accipitridae		
Red-tailed Hawk	*Buteo jamaicensis*	UC
Phasianidae		
Ruffed Grouse	*Bonasa umbellus*	O*
Rallidae		
Sora	*Porzana carolina*	O
Gruidae		
Sandhill Crane	*Grus americana*	C
Charadriidae		
Killdeer	*Charadrius vociferus*	A
Scolopacidae		
Upland Sandpiper	*Bartramia longicauda*	O
Marbled Godwit	*Limosa fedoa*	UC - C
Common Snipe	*Gallinago gallinago*	C - A
Wilson's Phalarope	*Phalaropus tricolor*	O
Laridae		
Ring-billed Gull	*Larus delawarensis*	R
Black Tern	*Chlidonias niger*	C
Columbidae		
Mourning Dove	*Zenaida macroura*	A
Picidae		
Yellow-bellied Sapsucker	*Sphyrapicus varius*	R
Downy Woodpecker	*Picoides pubescens*	UC - C
Hairy Woodpecker	*Picoides villosus*	A
Northern Flicker	*Colaptes auratus*	A
Tyrannidae		
Alder Flycatcher	*Empidonax alnorum*	O
Least Flycatcher	*Empidonax minimus*	UC - C
Eastern Phoebe	*Sayornis phoebe*	A
Western Kingbird	*Tyrannus verticalis*	O
Eastern Kingbird	*Tyrannus tyrannus*	R
Alaudidae		
Horned Lark	*Eremophila alpestris*	UC
Hirundinidae		
Tree Swallow	*Tachycineta bicolor*	O
Barn Swallow	*Hirundo rustica*	C
Corvidae		
Blue Jay	*Cyanocitta cristata*	A
Black-billed Magpie	*Pica pica*	UC
American Crow	*Corvus brachyrhynchos*	A

Family Common name	Scientific name	Abundance
Paridae		
Black-capped Chickadee	*Parus atricapillus*	A
Sittidae		
White-breasted Nuthatch	*Sitta carolinensis*	C
Certhiidae		
Brown Creeper	*Certhia americana*	UC
Troglodytidae		
House Wren	*Troglodytes aedon*	C
Sedge Wren	*Cistothorus platensis*	C
Marsh Wren	*Cistothorus palustris*	A
Muscicapidae		
Eastern Bluebird	*Sialia sialis*	UC
Veery	*Catharus fuscescens*	A
Wood Thrush	*Hylocichla mustelina*	O
American Robin	*Turdus migratorius*	A
Mimidae		
Gray Catbird	*Dumetella carolinensis*	UC
Bombycillidae		
Cedar Waxwing	*Bombycilla cedrorum*	R
Sturnidae		
European Starling	*Sturnus vulgaris*	UC
Vireonidae		
Warbling Vireo	*Vireo gilvus*	A
Red-eyed Vireo	*Vireo olivaceus*	A
Parulidae		
Nashville Warbler	*Vermivora ruficapilla*	A
Tennessee Warbler	*Vermivora peregrina*	A
Yellow Warbler	*Dendroica petechia*	A
Chestnut-sided Warbler	*Dendroica pensylvanica*	R
Black-and-white Warbler	*Mniotilta varia*	O
American Redstart	*Setophaga ruticilla*	A
Ovenbird	*Seiurus aurocapillus*	A
Northern Waterthrush	*Seiurus noveboracensis*	UC*
Common Yellowthroat	*Geothlypis trichas*	A
Canada Warbler	*Wilsonia canadensis*	R
Cardinalidae		
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	A
Emberizidae		
Rufous-sided Towhee	*Pipilo erythrophthalmus*	R
Chipping Sparrow	*Spizella passerina*	A
Clay-coloured Sparrow	*Spizella pallida*	A
Vesper Sparrow	*Pooecetes gramineus*	A
Lark Sparrow	*Chondestes grammacus*	C
Savannah Sparrow	*Passerculus sandwichensis*	A
Le Conte's Sparrow	*Ammodramus LeConteii*	UC
Song Sparrow	*Melospiza melodia*	A
Swamp Sparrow	*Melospiza georgiana*	R
White-throated Sparrow	*Zonotrichia albicollis*	O
Dark-eyed Junco	*Junco hyemalis*	O

Family	Common name	Scientific name	Abundance
Icteridae			
	Bobolink	*Dolichonyx oryzivorus*	O
	Red-winged Blackbird	*Agelaius phoeniceus*	A
	Western Meadowlark	*Sturnella neglecta*	A
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	UC
	Brewer's Blackbird	*Euphagus cyanocephalus*	R
	Common Grackle	*Quiscalus quiscula*	R
	Brown-headed Cowbird	*Molothrus ater*	C
	Northern Oriole	*Icterus galbula*	R
Fringillidae			
	American Goldfinch	*Carduelis tristis*	A
Passeridae			
	House Sparrow	*Passer domesticus*	UC-C

* Relative abundance descriptions based on Cleveland et al. (1988).
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Appendix H. General ecological preferences of the 15 most abundant carabid species.

Specimens collected on Gardenton PFRA Community Pasture. Information taken from Lindroth 1961-1969.

1. *Agonum cupripenne* (Say).—in open country, often on gravel or sand, where the soil is not too dry and the vegetation is thin; often near water but not confined to its vicinity.
2. *Agonum cupreum* Dejean.—not at all hygrophilous; occurs in open country with sparse vegetation, on ± sandy soil; most abundant on the prairie.
3. *Poecilus lucublandus* (Say).—on open, moderately dry ground with vegetation of grasses, etc.
4. *Carabus meander meander* Fischer.—rather hygrophilous, confined to open, moist ground with rich but moderately high vegetation; invades open meadows in humid climates.
5. *Agonum errans* (Say).—very hygrophilous, at edges of standing water, usually on sand-mixed clay with no or scarce vegetation; also at ponds and lakes with pronounced salinity (on prairies).
6. *Chlaenius sericeus sericeus* (Forster).—on moderately moist, rather firm ground with dense vegetation, usually close to border of standing or running water.
7. *Pterostichus commutabilis* (Motschulsky).—on open meadow ground, not too dry, often on sand-mixed soil.
8. *Pterostichus melanarius* (Illiger).—in light forest and on open meadows, cultivated land, waste places, etc. This species was introduced from Europe.
9. *Agonum gratiosum* (Mannerheim).—less hygrophilous than other members of the subgenus *Europhilus*; on open, usually moderately moist ground, often with considerable peat content; independent of open water.
10. *Chlaenius alternatus* Horn.—on borders of slow rivers, with firm soil, or lake shore with variable vegetation, i.e. distinctly hygrophilous.
11. *Harpalus pensylvanicus* (DeGeer).—open dry country, with moderately dense, often high vegetation; in cultivated fields, gravel pits, on roadsides, etc. Adults feed on seeds and roots of grasses, or on other insects.
12. *Pterostichus novus* Straneo.—dense, moist hardwood forest among dead leaves near a small brook (at Aweme only). This species has also been associated with alvar habitats in Ontario and Quebec.
13. *Synuchus impunctatus* (Say).—open country and light forests, on rather dry ground (usually moraine) among leaves under bushes.
14. *Bembidion patruele* Dejean.—border of standing and slowly moving water, often small temporary pools where soil is rich in organic matter, with sparse vegetation.
15. *Dyschirius sphaericollis* (Say).—almost constantly in company of *Bledius* (Coleoptera: Staphylinidae) or Heteroceridae (Coleoptera) on barren banks and shores of running and standing water.